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NATIONAL DAM SAFETY PROGRAM. LAKE SOLITUDE DAM (NJ00123), RARIT--ETC(U)
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RARITAN RIVER BASIN
SOUTH BRANCH RARITAN RIVER
HUNTERDON COUNTY
NEW JERSEY

LAKE SOLITUDE DAM
NJ 00123

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

U.S. ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT

DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

May, 1979

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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7. AUTHOR(s) 10 Robert J. Jenny ~~P.E.~~		8. CONTRACT OR GRANT NUMBER(s) 15 DACW61-78-C-0124
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Approved for public release; distribution unlimited.

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6 National Dam Safety Program. Lake Solitude Dam (NJ00123), Raritan River Basin, South Branch Raritan River, Hunterdon County, New Jersey. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	Masonry Dam
Spillways	Visual inspection
Embankment	Structural Analysis
Outlet works	National Dam Inspection Act Report
	Lake Solitude Dam, N.J.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

31 MAY 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Solitude Dam in Hunterdon County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Solitude Dam, a high hazard potential structure, is judged to be in fair overall condition. However, the spillway is considered seriously inadequate since 16 percent of the Probable Maximum Flood (PMF) would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated

within calendar year 1980. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the masonry dam and earth embankment foundation condition and structural stability. This should include test borings to determine material properties relative to stability and seepage and installation of piezometers to facilitate seepage studies. Any remedial measures found necessary should be initiated within calendar year 1980.

c. The following remedial actions should be initiated within six months from the date of approval of this report:

(1) The embankment and masonry dam should be surveyed to confirm their as-built geometry. Monuments should be placed on the embankment, masonry dam, and the slope adjacent to the right abutment. The position of these monuments should be checked on a regular basis to detect any possible movement or distortion.

(2) Special attention should be given to monitoring the slope adjacent to the right abutment of the masonry dam. Remedial measures should be taken, should any significant movement of this slope appear imminent.

(3) Additional evaluation of the emergency outlet works are required to confirm their present condition and determine if they are operational. The outlets should be made operable.

(4) The emergency outlet controls located on the crest of the masonry dam should be made accessible even when water is flowing over the dam.

(5) The poor condition of the penstock could result in complete failure of this structure either at its downstream end or within the embankment. Water should be prevented from passing into the penstock by thoroughly sealing its intake.

(6) The reservoir should be lowered below the crest of the dam so that a thorough inspection of the masonry dam, including the outlet works, can be performed.

NAPEN-D
Honorable Brendan T. Byrne

(7) A program of inspections of the dam during and after floods and annually should be initiated by the owners, utilizing the standard visual checklist in this report. A permanent record should be kept of all maintenance and operating events of the dam and reservoir.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James A. Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
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Trenton, NJ 08625

LAKE SOLITUDE DAM (NJ00123)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 4 and 21 December 1978 by Jenny-Leedshill Engineers under contract to the State of New Jersey. The State, under agreement with the U. S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Lake Solitude Dam, a high hazard potential structure, is judged to be in fair overall condition. However, the spillway is considered seriously inadequate since 16 percent of the Probable Maximum Flood (PMF) would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the masonry dam and earth embankment foundation condition and structural stability. This should include test borings to determine material properties relative to stability and seepage and installation of piezometers to facilitate seepage studies. Any remedial measures found necessary should be initiated within calendar year 1980.

c. The following remedial actions should be initiated within six months from the date of approval of this report:

(1) The embankment and masonry dam should be surveyed to confirm their as-built geometry. Monuments should be placed on the embankment, masonry dam, and the slope adjacent to the right abutment. The position of these monuments should be checked on a regular basis to detect any possible movement or distortion.

(2) Special attention should be given to monitoring the slope adjacent to the right abutment of the masonry dam. Remedial measures should be taken, should any significant movement of this slope appear imminent.

(3) Additional evaluation of the emergency outlet works are required to confirm their present condition and determine if they are operational. The outlets should be made operable.

(4) The emergency outlet controls located on the crest of the masonry dam should be made accessible even when water is flowing over the dam.

(5) The poor condition of the penstock could result in complete failure of this structure either at its downstream end or within the embankment. Water should be prevented from passing into the penstock by thoroughly sealing its intake.

(6) The reservoir should be lowered below the crest of the dam so that a thorough inspection of the masonry dam, including the outlet works, can be performed.

(7) A program of inspections of the dam during and after floods and annually should be initiated by the owners, utilizing the standard visual checklist in this report. A permanent record should be kept of all maintenance and operating events of the dam and reservoir.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 31 May 1979

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN

24 MAY 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

This is in reference to our ongoing National Program for Inspection of Non-Federal Dams within the State of New Jersey. Lake Solitude Dam (Federal I.D. No. NJ00123), a high hazard potential structure, has recently been inspected. The dam is owned by S. R. Casells, M.D. and is located on the South Branch of the Raritan River approximately a half mile upstream of the Borough of High Bridge in Hunterdon County.

Using Corps of Engineers screening criteria, it has been determined that the dam's spillway is seriously inadequate since approximately 16 percent of the Probable Maximum Flood would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise, or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard potential to loss of life downstream from the dam. As a result of this UNSAFE determination, it is recommended that the dam's owner take the following measures within 30 days of the date of this letter:

a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measures required to prevent overtopping of the dam.

NAPEN-D
Honorable Brendan T. Byrne

b. In the interim, a detailed emergency operation plan and downstream warning system should be developed. Also, round-the-clock surveillance should be provided during periods of unusually heavy precipitation.

A final report on this Phase I Inspection will be forwarded to you within two months.

Sincerely,

Joel Kolleker LTC
JAMES G. TON
Colonel, Corps of Engineers
for District Engineer

Cy Furn:
Dirk C. Hofman, Actg Deputy Director
Divsion of Water Resources
N. J. Dept of Environmental Protection
P. O. Box CN029
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John O'Dowd, Acting Chief
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UNSAFE DAM
NATIONAL PROGRAM OF INSPECTION OF DAMS

a. NAME: Lake Solitude Dam

b. ID NO.: NJ00123

c. LOCATION State: New Jersey County: Hunterdon
River or Stream: S. B. Raritan River
Nearest D/S City or Town: High Bridge

d. HEIGHT: 42 feet

e. MAXIMUM IMPOUNDMENT CAPACITY: 700 ac. ft.

f. TYPE: Combination Masonry Gravity and Earthfill

g. OWNER: S. R. Casells, M.D., Wyncote, Pa.

h. DATE GOVERNOR NOTIFIED OF UNSAFE CONDITIONS: 24 May 79.

i. CONDITION OF DAM RESULTING IN UNSAFE ASSESSMENT
Preliminary report caculations indicate 16% of PMF would overtop the dam.

j. DESCRIPTION OF DANGER INVOLVED: Overtopping and failure of the dam significantly increases hazard potential to loss of life and property downstream of dam.

k. RECOMMENDATIONS GIVEN TO GOVERNOR: Within 30 days of date of District Engineer letter the owner do the following:
a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analysis, and to recommend any remedial measures required to prevent overtopping of the dam.
b. In the interim, a detailed emergency operation plan and downstream warning system should be developed. Also, around-the-clock surveillance should be provided during periods of unusually heavy precipitation.

l. URGENCY CATEGORY: UNSAFE, Non-Emergency

m. EMERGENCY ACTIONS TAKEN:
Governor notified of this condition by District Engineer's letter of 24 May 79.

n. REMEDIAL ACTIONS TAKEN:
NJDEP will notify dam's owner upon receipt of our letter.

o. REMARKS: Final Report, to be issued within six weeks, will have WHITE cover.

PJBraun
for
W. H. ZINK, Coordinator
Dam Inspection Program
U.S.A.E.D., Philadelphia

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Lake Solitude Dam
	Federal I.D. No. NJ 00123
	New Jersey I.D. No. 24-57
State Located:	New Jersey
County Located:	Hunterdon
Stream:	South Branch Raritan River
Dates of Inspection:	December 4 and 21, 1978

Brief Assessment of General Condition of Dam

Based on visual inspection the masonry dam and embankment appear to be in fair condition; however, the available data are not sufficient to quantitatively analyze their structural stability.

The spillway can pass only 15 percent of the Probable Maximum Flood without overtopping the dam and is considered seriously inadequate.

The emergency outlet is inaccessible when water is flowing over the spillway and the condition of the outlet is not known. The abandoned penstock is badly corroded and could fail completely at any time, with unknown consequences.

Recommendations and the urgency of their implementation are as follows:

1) The emergency outlet should be inspected very soon to determine its present condition. Permanent access to outlet controls should be provided.
2) Either by the emergency outlet if operable or by other means, the reservoir should be lowered below the dam

crest very soon so that a thorough inspection of the masonry dam and outlet can be performed.

3) More sophisticated and detailed hydrologic and hydraulic analyses of the spillway capacity should be performed as soon as possible.

4) A program of borings and laboratory tests should be performed soon to determine the physical properties of the embankment. Piezometers should also be installed and read periodically to establish the internal water levels. These data should be evaluated and used by an experienced geotechnical engineer to perform seepage and stability analyses.

5) The embankment and masonry dam should be surveyed as soon as possible to determine their as-build geometry. Monuments should be placed on these structures and the slope adjacent to the right abutment. The position of these monuments should be checked regularly to detect any movement or distortion.

6) The intake to the penstock should be thoroughly sealed off as soon as possible.

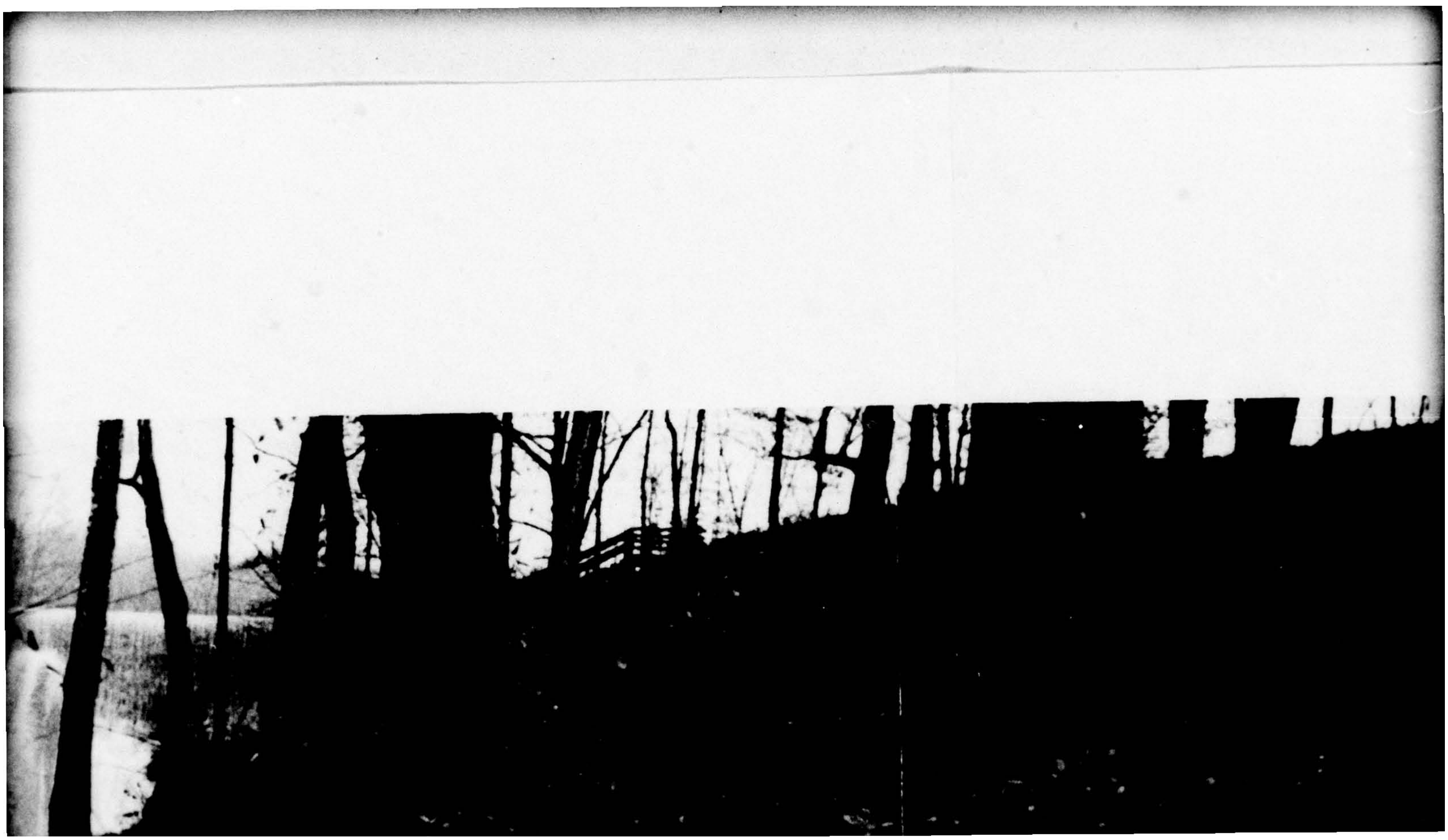
7) A program of inspection of the dam during and after floods and annually should be initiated, and timely repairs be made.

8) A warning system should be established soon whereby downstream inhabitants may be notified and evacuated in the event of possible dam failure.

Frank L. Panuzio

Frank L. Panuzio, P.E
Project Engineer

Robert J. Jenny, P.E
Project Director
New Jersey License No. 9878



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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

LAKE SOLITUDE DAM

Federal I.D. No. NJ 00123
New Jersey I.D. No. 24-57

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The National Dam Inspection Act, Public Law 92-367, 1972, provides for the National Inventory and Inspection Program by the U. S. Army Corps of Engineers. This report has been prepared in accordance with this authority, through contract between the State of New Jersey and Jenny-Leedshill Engineers. The State of New Jersey has also entered into an agreement with the U. S. Army Engineer District, Philadelphia, to have this work performed.

b. Purpose of Inspection

The purpose of this inspection was to evaluate the general structural integrity and hydraulic adequacy of the dam, and to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project

a. Description of Dam and Appurtenances

The dam is a combination masonry gravity and earthfill structure. The overflow section is an ashlar masonry structure with steel I-beam reinforcement set in concrete, approximately 210 feet long and 42 feet high. The width of the crest is 4 feet and the base between buttresses is approximately 16 feet wide. The upstream slope is vertical and the downstream slope is 0.29-foot horizontal in 1-foot vertical. There are four buttresses on the downstream side of the masonry structure which have a maximum longitudinal width at the base of 40 feet.

An earth embankment is located to the left of the masonry overflow structure. The extent of the natural and man-made portions of this embankment is not known with certainty, but the original embankment is believed to have been about 500 feet long. The width of the present embankment varies from about 50 feet to about 200 feet, due to fill which was subsequently dumped downstream of the original embankment. The upstream side is gently sloping and the downstream slope varies from about 1 to 2.5 horizontal to 1 vertical.

The reservoir originally had three outlets; two through the embankment and one through the masonry structure. A now unusable masonry intake structure with slide gates is located on the left third of the embankment and outlets via a 6-foot diameter steel penstock. The penstock supplied water for a power generating turbine which is now abandoned. The second outlet which passes under the right third of the embankment consists of a 8-inch diameter steel pipe in a concrete lined horseshoe tunnel, with a maximum width of 4 feet and height of 3.3 feet. The third outlet consists of a 3-foot diameter conduit which passes through the base of the right third of the masonry structure. The flap gate is operated from the crest of the dam, by a system of pullies and a lever arm.

b. Location

Lake Solitude Dam is located in northwest New Jersey on the South Branch Raritan River approximately 1/2 mile upstream of the Borough of High Bridge, Hunterdon County. The regional vicinity plan is presented on Plate 1.

c. Size Classification

The maximum height of Lake Solitude Dam is 42 feet, therefore, the size classification of the dam is intermediate, even though the dam's size classification is "small" based on its storage capacity of 700 acre-feet when the reservoir is at the top of the dam.

The criteria for size classification of dams are set forth in the Corps' Guidelines. An intermediate size dam is one in which the reservoir capacity is greater than or equal to 1000 acre-feet and less than 50,000 acre feet, and/or the maximum height is greater than or equal to 40 feet and less than 100 feet.

d. Hazard Classification

The Borough of High Bridge, which has a population of approximately 2,500 is situated about 1/2 mile downstream from the dam. Inspection of the downstream channel and routing of the design flood indicates that at least 12 buildings, roads and a section of a railroad would be inundated, which could result in the loss of more than a few lives and excessive economic loss. Two houses are located near the left bank of the flood plain, immediately downstream of the embankment, may be flooded should the embankment be overtopped. Therefore, the dam merits a high hazard classification.

e. Ownership

The dam is owned by S. R. Casells, M.D., Cedar Brook Heights Apartments No. 3, Suite C-Ml, Wyncote, Penn. 19095.

f. Purpose of Dam

The reservoir was originally used to provide hydroelectric power to the Taylor Iron and Steel Company Mill, but is now used only for recreation.

g. Design and Construction History

The masonry dam was designed by F. S. Tainter and constructed in 1909 for Taylor Iron and Steel Company. The available drawings refer to this structure as a steel compression dam with patent pending. There is no information about the design and construction of any man-made portion of the earth embankment or of the outlets which pass through the embankment.

h. Normal Operational Procedure

There is no known regulation of the dam, and it appears that all the outlets may be inoperable. Water flows unregulated over the masonry dam, controlled only by the level of the reservoir.

1.3 Pertinent Data

a. Drainage Area (sq. mi.)	65.3
b. Discharge at Damsite (cfs)	
Ungated spillway capacity at maximum pool elevation	7000
c. Elevation (ft. above MSL)	
Top Dam (left abutment of masonry dam)	305.7
Spillway crest	301
Streambed at centerline of dam	263
d. Reservoir Length (ft.)	
Maximum pool (top of dam)	4900
Recreation pool (spillway crest)	4600

e. Storage (acre-feet)

Recreation pool (spillway crest)	540
Top of dam	700

f. Reservoir Surface (acres)

Top dam	36
Spillway crest	32

g. Masonry Section

Type	Buttressed ashlar masonry dam reinforced with steel I beams.
Length	217 ft.
Height	42 ft.
Top Width	4 ft.
Side Slopes - Upstream	Vertical
- Downstream	0.29 H:1V

h. Embankment Section

Type	Earthfill with coal cinders and slag possibly added on downstream side
Length	500 ft. (Approx.)
Height	30 ft. (Approx.)
Top Width	50 to 200 ft.
Side Slopes - Upstream	Unknown
- Downstream	Variable; 1.5H:1V Average
Zoning	Unknown
Impervious Core	Unknown
Cutoff	Unknown
Grout Curtain	Unknown

i. Spillway

Type	Entire masonry dam
Length of weir	210 ft.
Crest elevation	301 ft.
D/S Channel	Stepped D/S face of dam and natural river channel. Stilling pool at base of dam extending approximately 50 feet downstream.

j. Regulating Outlets (all believed inoperable)

a. Sluice gate and 6-ft. diameter steel penstock which passes through the left third of the embankment.

b. 8-inch diameter steel pipe passes through a concrete lined horseshoe tunnel with a maximum width of 4 ft. and height of 3.3 ft., located at the right third of the embankment.

c. 3-ft. diameter conduit with hinged gate located at right third of masonry dam.

SECTION 2: ENGINEERING DATA

2.1 Design

a. Geologic Conditions

Lake Solitude Dam and its reservoir are located in a relatively narrow north-south trending valley in the southern portion of the New Jersey Highlands physiographic province. The regional geology of this province is discussed in Appendix C to this report.

The dam site consists of a steep right abutment with exposed bedrock. The left abutment is more gently sloped and no bedrock could be seen in the immediate area of the abutment. The masonry section appears to be situated on bedrock.

Overburden near the dam site includes recent alluvium in the stream bottom and old stratified glacial deposits and old glacial tills on the side slopes and on the ridges. These old glacial deposits are the result of pre-Wisconsin Age glaciation and are typically weathered. According to the Warren County Engineering Soil Survey (Engineering Research Bulletin Number 27, Rutgers University, 1954), depth to rock on the side slopes is shallow, usually less than 10 feet.

Bedrock observed in the area is a competent black and white granite gneiss with joints and well developed foliation. The weathered rock zone at the overburden-bedrock contact is typically less than one foot thick.

The right abutment of the dam has been constructed in a notch cut into the bedrock. Because the overlying soil was not excavated at a stable slope angle, it has continued to slough into the excavation and a scrap approximately 20 feet wide by 15 feet high has developed in the overburden. The soil cover is potentially unstable, but this condition probably does not threaten the structural stability of the dam. However, the slope adjacent to the right abutment should be monitored for possible movement.

As stated, it appears that the masonry spillway section of the dam is founded on bedrock. No bedrock was observed under or adjacent to the embankment section which composes the left abutment side of the dam. Typically, an embankment dam is designed with the minimum volume of soil required to make the embankment safe. In this project, the embankment crest width is very wide (up to approximately 200 feet), variable and built quite high above normal reservoir levels. In other words, it appeared that there was much more material than would normally be required for a dam. This configuration indicates that the embankment portion of the dam may be at least partly built of coal cinders and slag generated by the now abandoned steel mill approximately one quarter mile downstream of the dam. Other observations which would support this theory include a single line railroad track which runs up to near the downstream toe of the dam which may have been used for hauling the cinders; the lack of a borrow area in the immediate vicinity of the dam where embankment materials would normally be obtained; and the presence of black soil and some cinders observed in non-vegetated patches in the embankment and downstream of the dam. If this theory is true, and the dam was used as a cinder dump, then much of the embankment portion may be "non-engineered" structure.

Lake Solitude Dam is situated within Seismic Zone 1. No active faults are known to exist in the immediate vicinity of the dam and only minor damage from distant earthquakes should be expected.

b. Design Data

The available drawings indicate that the masonry dam was designed by F. S. Tainter. The masonry dam is referred to as a steel compression dam with patent pending. The plans indicate that there were to be 6 buttresses on the downstream face of the dam (Plates 3 and 4); however, field observations revealed that there are only 4 buttresses. Thus the available plans apparently represent an earlier design. Plans indicate that the dam was designed with a skeleton of 12-inch steel I-beams set in concrete in the core of the dam (Plate 5).

The foundation of the masonry dam was designed to be keyed into rock along the base and right abutment. A masonry retaining wall is located at the left abutment between an earth embankment and the masonry dam. The length of the masonry dam is approximately 175 feet, but the excavation of rock from the right abutment gives an effective crest length of 210 feet.

A 3-foot diameter outlet passes through the right third of the masonry dam. The circular flap gate is controlled by pullies and a lever arm and is operated manually by two crank winches located at the crest of the dam (Plate 6).

The reservoir is also impounded by an earth embankment approximately 500 feet long. The extent of the natural and man-made portions is not known and there are no data regarding the design or construction of the embankment. Based on an old topographic survey (Plate 2), it would appear that the original man-made embankment extended the full 500 feet length of what is now the upstream side of a much wider embankment formed by subsequent dumping of waste material. An 8-inch diameter steel pipe is located in a concrete lined tunnel with a horseshoe cross section having a maximum width of 4 feet and a height of 3.3 feet, which passes through the right third of the embankment. It is assumed that the 8-inch pipe has an inlet somewhere in the reservoir, but neither the location of the inlet nor the purpose of the pipe is known. Flow is controlled by a gate valve at bottom of a concrete chamber in the embankment.

A 6-foot diameter steel penstock passes through the left third of the embankment and was designed to provide water to the turbine of a hydroelectric power plant located approximately 700 feet downstream. This plant provided electric power to the Taylor Steel and Iron, Co. mill located about 1/4 mile downstream from the dam.

The drawings (Plate 2 and 3) show a railroad track terminating at the right end of the embankment. No information is available regarding the intent of this railroad line, but it may be assumed that it was used to transport fill for the embankment and/or construction materials for the masonry structure.

2.2 Construction

The 'Dams in New Jersey - Reference Data No. 24-57' dated 1/4/26 gives the date of construction as December 1909. No other information regarding the construction of the dam is available.

2.3 Operations

There are no available records regarding the operation of the dam and reservoir. The reservoir is presently unregulated.

2.4 Evaluation

a. Availability

Available engineering data are limited to plans and sections of the masonry portion of the dam and the masonry dam outlet works (Plates 2 through 6). The penstock through the embankment described in section 2.1-b is shown schematically in Plate 2; however, no additional details regarding this structure or the smaller outlet through the embankment are available.

b. Adequacy

The available design and construction data are inadequate to evaluate the structural stability of the dam or appurtenant structures.

c. Validity

Visual inspection of the dam indicates that there are discrepencies between the available design drawings and as-built configuration of the dam. The buttresses near each end of the masonry structure shown on Plates 3 and 4, are not present. Observation from the abutments indicates that the outlet controls located on the crest of the masonry dam do not appear to be as shown on Plate 6.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

Visual inspections of Lake Solitude Dam were made on December 4 and 21, 1978. The reservoir elevation was 4 inches above the crest of the spillway during the first inspection and was discharging over the entire face of the masonry dam.

The visual inspection did not reveal any critical signs of distress in the dam. All outlets are apparently inoperable and water was observed leaking through the abandoned penstock and tunnel at the right third of the embankment. Soil covering the bedrock on the right abutment, in the vicinity of the excavation made adjacent to the masonry dam, appear to be potentially unstable.

Detailed inspection was made of the dam, appurtenant structures, reservoir area, and the downstream channel. Descriptions of the findings of these inspections are summarized in the paragraphs which follow. The checklist of visual inspection items is included in Appendix A. Geologic and foundation conditions observed at the time of inspection are noted in greater detail in Section 2.1-a.

b. Dam

The masonry dam and the embankment were inspected for signs of settlement, seepage, erosion, cracking, and any other evidence of undesirable behavior which might affect the stability of the structure.

Masonary Section

The entire length of the masonry section, referred to as a 'steel compression dam' in the plans, acts as the spillway for the reservoir. Water flowing over this structure during the inspection restricted the inspection; however, there did not appear to be any indication of severe distortion or distress. The dam appeared to be in good vertical and horizontal alignment and there was a very uniform flow of water over the crest (Photo 1). The available plans indicate that there were to be 6 buttresses on the downstream face of the dam; however, only 4 were observed (Overview Photo).

The face of the dam is constructed of cut stones measuring approximately 1 ft. by 1 ft. by 3 ft. The concrete cap on the crest appears to be in good condition. The masonry retaining wall and left abutment appear to be in good condition. Minor erosion of the embankment has occurred immediately behind the retaining wall.

The depth of water in the stilling pond was greater than 6 feet during the inspection; therefore, the foundation of the masonry structure could not be observed.

The right side of the spillway is formed by excavation of a notch in the abutment bedrock. The flow of water in this area prevented thorough inspection of the abutment.

The steep embankment adjacent to the right abutment shows signs of instability. There was evidence of a recent slide of the superficial soil just downstream of the dam as indicated by exposed tree roots and tilted trees (Photo 2).

Embankment Section

There is an embankment approximately 500 feet long located to the left of the masonry structure. From the visual inspection it was not possible to determine which portions of this embankment are controlled fill, dumped material or natural.

Much of the embankment appears to consist of black silty sand which could be cinders from the steel mill. White sand has been placed to form a beach at the edge of the reservoir. The embankment is somewhat irregular in section and profile. The upstream face of the embankment is gently sloping (Photo 3) and the downstream slope is steeply dipping (Photo 4). The surface of the embankment is undulating and there is no well defined crest. Grass and brush cover most of the upstream side of the embankment and a heavy growth of trees covers the downstream face. Minor local slumps were noted on the downstream face and a dirt road extends along the entire downstream toe of the embankment.

c. Appurtenant Structures

Outlet Works

The reservoir originally had three outlets, one through the masonry dam and two through the embankment.

The outlet through the base of the masonry dam is shown on Plate 6. The controls to this outlet are located on the crest of the dam (Photo 1). This outlet, including the gate controls, were inaccessible for inspection due to water passing over the dam. Any former access devices or structures, such as cable rigging or a bridge, have been destroyed.

A concrete lined tunnel passes through the right third of the embankment and exits into a channel with masonry walls (Photo 5). This discharge channel is approximately 3 feet high by 5 feet wide and empties into the South Branch Raritan River downstream from the dam as shown on

Plate 2. The tunnel is horseshoe shaped in section and has a maximum width of 4 feet and height of 3.3 feet. Water was flowing from this tunnel at a rate of approximately 10 gallons per minute. A 6 foot square concrete shaft (Photo 3) located on the crest of the embankment provides access to the tunnel. There is a hinged steel plate on the top of this structure and a steel ladder built into the inside of the shaft. At the base of the shaft there is a gate valve and an 8-inch cast iron pipe leading into the tunnel. It is presumed that the pipe leads to an intake structure in the reservoir, but the location of the intake is not known.

The third outlet was the water supply for the now abandoned hydroelectric power plant (Plate 2). The intake consists of a masonry structure located on the left third of the embankment with sliding gate and steel grate trash cover. The intake is almost completely blocked by sediment and debris (Photo 6). The masonry structure is generally in fair condition with a few dislodged stones, however, the gate which is guided by two steel channels is inoperable.

The 6-foot diameter steel penstock exits from under the embankment adjacent to the abandoned concrete power house (Photo 7). The steel is badly corroded and a jet of water was leaking from a hole rusted out at the base of the penstock where it goes underground to connect to the power house (Photo 8). A jet of water was also noted coming out of a hole in the turbine (Photo 9).

Reservoir

The reservoir slopes are relatively steep and heavily wooded (Photo 10). With the exception of the potentially unstable slope adjacent to the right abutment of the dam discussed above and in Section 2.1-a, the slopes appear stable.

The water was clear and there was no noticable debris or indication of excessive sedimentation, except as noted at the intake to the penstock.

A small island is located at the upper end of the reservoir.

Downstream Channel

A stilling pond is located at the base of the masonry dam. The depth of water in the pool was greater than 6 feet adjacent to the left abutment at the time of the inspection.

Broken sections of what appear to be a training wall were noted on the left bank of the downstream channel where the stilling pond narrows into the channel (Photo 11).

The right bank is steeply sloping and the left bank is gently sloping. Both banks are heavily wooded.

The channel has a relatively steep gradient with some minor rapids (Photo 12).

A railroad and road bridge, a closed steel mill and numerous houses are located approximately 1/4 to 1/2 mile downstream. Two houses are located about 300 feet downstream of the left abutment of the embankment, at approximately the same elevation as the embankment crest. Routing of the design flood indicates that at least 12 buildings, roads and a section of a railroad would be inundated, which could result in the loss of more than a few lives and excessive economic loss.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

There is no known regulation of the dam, and all the outlets appear to be inoperable. The reservoir level is determined by unregulated discharge over the spillway on the masonry section of the dam.

4.2 Maintenance of the Dam

At the present time there is no program of regular inspection or maintenance of the dam. No records of maintenance work are available. There are no instrumentation or monitoring systems on the dam or reservoir.

4.3 Maintenance of Operating Facilities

There is no program of regular inspection or maintenance of the outlet works. The intake to the penstock outlet is inoperable and the other outlets appear to be inoperable. The hydroelectric plant has been abandoned and both the penstock and the turbine are badly corroded and leaking.

4.4 Description of Warning Systems

There is no warning system associated with the dam and operating facilities nor any procedures for warning downstream inhabitants in the event of possible failure of the dam.

4.5 Evaluation of Operational Adequacy

Operation of the dam and appurtenant structures are inadequate to properly maintain the dam. There is presently no way to gain access to the emergency outlet in the masonry section of the dam when water is flowing over the spillway, even if the outlet were operable. Further corrosion of the penstock could result in complete failure of this structure and possible breach of the embarkment section.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

As already stated in Section 1.2, Lake Solitude Dam is classified as high hazard and intermediate in size. In accordance with the Corps of Engineers' "Recommended Guidelines for Safety Inspection of Dams" the spillway Design Flood (SDF) is the Probable Maximum Flood (PMF).

Data obtained for the Corps indicated the drainage basin area of the dam is 65.3 square miles. Elevations within the basin range from a maximum of about 1100 feet above mean sea level along the northern perimeter to about 260 feet in the valley floor. Only a small portion of the land within the watershed is occupied by commercial, industrial or residential developments. About 0.1 percent of the watershed area is the reservoir of the dam. The drainage basin is delineated on a U.S.G.S. topographic map and is presented on Plate D-1, Appendix D.

The hydraulic and hydrologic features of the dam were evaluated using criteria set forth in the Corps of Engineers', "Recommended Guidelines for Safety Inspection of Dams" and additional guidance and criteria provided by the Philadelphia District, Corps of Engineers. The analysis was conducted using the Corps' computer program HEC-1, Dam Break Version (HEC-1, DB).

The Philadelphia District of the Corps of Engineers supplied the PMF inflow hydrograph to be used in the analysis of Lake Solitude. Using this inflow hydrograph, the HEC-1 DB program computed the peak discharges of the 25 percent, 50 percent, 75 percent and 100 percent PMF. These discharges are 12,125 cfs, 24,250 cfs, 36,375 cfs, and 48,500 cfs, respectively.

The various percentages of the PMF inflow hydrograph were routed through the reservoir using the Modified Puls Method by the HEC-1 DB program. The peak outflow discharges of the 25 percent, 50 percent, 75 percent and 100 percent PMF were calculated to be essentially the same as the inflow discharges. Because of errors in interpolation of data the computer program did not calculate any significant flood attenuation. The flood routings indicate that all floods greater than about 15 percent of the PMF will overtop the embankment. A plot of percent PMF versus peak outflow discharge is presented as Plate D-2 in Appendix D.

The spillway and overtop stage-discharge rating curve used in the flood routings was calculated using the weir equation and assuming free overflow across the spillway and embankment. The spillway, which is the entire length of the masonry portion of the dam, is a 4-foot wide weir with an estimated discharge coefficient of 3.3. During high reservoir stages some outflow will occur over the embankment. The weir equation, with coefficients that varied with embankment vegation, was used to calculate these flows. These overflows were added to the spillway discharges and input to the computer program. Because overtopping discharges were included in the spillway stage-discharge rating curve, the computer printout included in Appendix D does not indicate the dam is overtopped. However, comparison of peak reservoir stage and the embankment crest elevation shows that, during the PMF, the embankment is overtopped by about 8 feet. The reservoir stage-storage curve was determined from U.S.G.S. 7.5 - minute topographic maps and data obtained from State files. The stage-storage curve was extended above the dam crest to include surcharge storage during peak flood discharges. In the reservoir routing computations possible discharges through the outlet works were excluded because their capacity is small compared to the PMF and because of the possibility that the outlet valves may be closed or inoperable. The stage-storage and the spillway and overtop stage-discharge curves are presented in Appendix D as Plates D-3 and D-4, respectively.

The various percentages of the PMF were routed 0.5 miles downstream through two successive reaches through the Borough of High Bridge. These routings were made to determine downstream flooding characteristics without dam failure. These flooding characteristics were compared to those that would result assuming the dam fails because of the inadequate capacity of its spillway. From this comparison the seriousness of the spillway's inadequacy was assessed.

The hydraulic parameters used in the HEC-1 DB program for the downstream routing calculations were estimated based on observations made in the field and information obtained from U.S.G.S. topographic maps. The locations of the cross-sections used in these routings are shown on page D-4, Appendix D.

The HEC-1, DB computer program was not used as a model for failure of Lake Solitude Dam. In general, the embankment on the left side of the spillway is extremely wide and, therefore, vertical degradation due to erosion would be slow. However, during the inspection it was observed that the embankment immediately adjacent to the spillway left abutment is relatively narrow and has a lower crest elevation than other portions of the embankment. Overtopping flows would first occur near the spillway left abutment and these flows would reenter the downstream channel just below the spillway. Because these reentry flows would have a high velocity, erosion near the spillway abutment would be fairly rapid. It was reasoned that, once the dam is overtopped, the embankment at the left abutment of the spillway would be eroded and the spillway support weakened. Subsequent high stages in the reservoir would then cause the spillway portion of the dam to fail rapidly and completely.

In order to assess the increase in downstream flood hazard resulting from dam failure the peak dam break discharge was calculated by hand. In these calculations it was assumed the dam would fail completely and instantaneously and at the time of maximum overtopping. The peak outflow discharges at the damsite were calculated using dam-break flow velocities and depths presented in test books on open channel hydraulics.[1] Peak discharges at downstream locations were estimated using attenuation factors, i.e., the ratios of downstream discharge to damsite discharge, that are indicated by the computer calculated values for the non-breach analysis.

In this manner, the flooding characteristics at the Borough of High Bridge were estimated assuming dam failure. The following tabulation compares these characteristics with the flooding characteristics assuming no failure of the dam.

[1] See Henderson, "Open Channel Hydraulics," Macmillan Series in Civil Engineering, 1966, p. 304.

	25% PMF	50% PMF	75% PMF	100% PMF
No Breaching				
Peak Discharge, cfs	12,000	24,030	36,460	48,350
Peak Flow Depth, ft	9.9	13.3	15.8	17.7
Peak Flow Width, ft	460	650	780	880
Peak Flow Velocity, fps	5.8	6.1	6.4	6.6
Breaching				
Peak Discharge, cfs	64,900	72,800	77,670	81,230
Peak Flow Depth, ft	19.7	20.7	21.2	21.6
Peak Flow Width, ft	980	1025	1050	1070
Peak Flow Velocity, fps	7.1	7.2	7.3	7.3

As shown in the above tabulation, there is a significant increase in downstream flooding. The dam breach flood stage just upstream of the Central Railroad tracts is several feet above the foundations of at least a dozen structures. Further downstream several additional structures would be innundated. Therefore, there is a significant increase in the hazard to loss of life and property damage should the dam fail.

It is reported there are three outlets for the dam. From field inspection it appeared that all three may be inoperable. If the emergency outlet were accessible and if it is operable, it is estimated that the drawdown time to drain the reservoir would be about 40 hours.

b. Experience Data

Records of lake levels are not maintained for this site. The dam was originally built for power generation but no longer operates as such. It is presently used for recreation. It is not known if the dam has been overtopped in the past.

c. Visual Observations

There is a well defined wide channel downstream of the dam. There were no visible dwellings along the stream immediately downstream of the dam, however, two dwellings are located downstream of the embankment's left abutment. The main channel is shallow with a fairly constant cross-section. The overbank is heavily wooded with little undergrowth.

d. Overtopping Potential

As indicated in Section 5.1-a, the Lake Solitude Dam spillway can pass only 15 percent of the PMF. During the PMF the dam would be overtopped a significant amount and could cause dam failure. There is a high hazard to loss of life in the downstream area and the downstream flooding hazards that would result should the dam fail are significantly higher than those that would exist without failure or just prior to failure. In accordance with the Corps' guidelines, the existing spillway for Lake Solitude Dam is classified as Seriously Inadequate.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

At the time of the inspections the dam did not exhibit any major signs of distress. However, leakage was occurring through the penstock and outlet tunnel, possibly endangering the embankment portion of the dam. Soil covering portions of the right abutment adjacent to the masonry dam appears to be potentially unstable, but this condition probably does not threaten the structural stability of the dam.

Water was flowing over the entire face of the masonry section of the dam during the inspections, which restricted inspection of this structure and made the emergency outlet works inaccessible for inspection. Similarly, the original embankment portion of the dam could not be inspected because it is obscured by a considerable volume of dumped waste material.

b. Design and Construction Data

The available design and construction data are inadequate to evaluate the structural stability of the dam since little is known of the design criteria and construction method and nothing is known of as-built conditions or materials. Data regarding the earth embankment are particularly lacking.

c. Operating Records

There are no operating records for the outlet works, nor records of reservoir levels or discharge over the dam. In addition, there are no instrumentation or monitoring devices on the dam.

d. Post-Construction Changes

The only known post-construction changes are the placement of dumped waste on the embankment and the abandonment of the hydroelectric power plant. The placement of fill downstream of the original embankment contributes some degree of structured stability to that section of the dam.

e. Seismic Stability

Since the area lies within Seismic Zone 1, only minor damage may be expected from distant earthquakes. No active faults are known to exist in the immediate vicinity nor surrounding area of the dam. In general, projects located within Seismic Zone 1 may be assumed to present no hazard from earthquakes, provided static stability conditions are satisfactory and conventional safety margins exist. Data are insufficient at this time to assess seismic stability.

SECTION 7: ASSESSMENT, RECOMMENDATIONS, PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

The present spillway is seriously inadequate and can only pass 15% of the Probable Maximum Flood without overtopping the embankment.

The structural stability of the masonry dam and the earth embankment cannot be quantitatively analyzed, due to lack of available data; however, visible inspection indicates that these structures are in fair condition. The most serious deficiencies are the lack of a readily accessible and operable emergency outlet and the badly corroded condition of the abandoned penstock.

b. Adequacy of Information

The information and data obtained are not adequate to perform a comprehensive, definitive evaluation of the structural stability of the dam. There are limited data regarding the design of the masonry portion of the dam; however, nothing is known about the construction of this structure. There is no available information regarding the design and construction of the embankment, nor of the outlets passing through the embankment.

c. Urgency

Certain recommendations are given below, the most urgent being rehabilitation of the outlet works which should be conducted very soon. Other recommendations are of a less urgent nature and should be implemented as soon as possible.

d. Necessity for Additional Data/Evaluation

Additional evaluation of the emergency outlet works are required to confirm their present condition and determine if they are operational. This evaluation should be performed very soon and steps taken to make the outlets operable.

At the present time there is insufficient information available to fully evaluate the structural stability of the masonry part of the dam. In addition, information necessary to evaluate the structural stability of the embankment is particularly absent. The Corps of Engineers Guidelines require that, in general, seepage and stability analyses should be on record for all dams in the high hazard category, such as Lake Solitude Dam. Because of the high hazard conditions downstream, the lack of any information on the embankment, and the apparent lack of operation of the dam for some time, additional investigations to determine the properties of the embankment and condition of the masonry dam are considered necessary, and should be performed as soon as possible. A program of borings and laboratory tests should be performed by the owners to determine the physical properties of the embankment and foundation so that seepage and stability analyses may be made. At the same time piezometers should be installed and then read periodically to determine the internal water levels. These data should be evaluated by an experienced geotechnical engineer.

The reservoir should be lowered below the crest of the dam so that a thorough inspection of the masonry dam, including the outlet works, can be performed. Further investigations would depend upon the results of this inspection.

The embankment and masonry dam should be surveyed soon to confirm their as-built geometry. Monuments should be placed on the embankment, masonry dam, and slope adjacent to the right abutment at the time. The position of these monuments should be checked on a regular basis to detect any possible movement or distortion.

The spillway capacity of the dam is seriously inadequate; therefore, more sophisticated and detailed hydrologic and hydraulic analyses should be performed as soon as possible. From it, a positive action program of corrective measures should be developed and implemented as necessary.

7.2 Remedial Measures

a. Corrective Procedures

The poor condition of the penstock could result in complete failure of this structure either at its downstream end or within the embankment. Water should be prevented from passing into the penstock by thoroughly sealing its intake, as soon as possible.

The emergency outlet controls located on the crest of the masonry dam should be made accessible even when water is flowing over the dam.

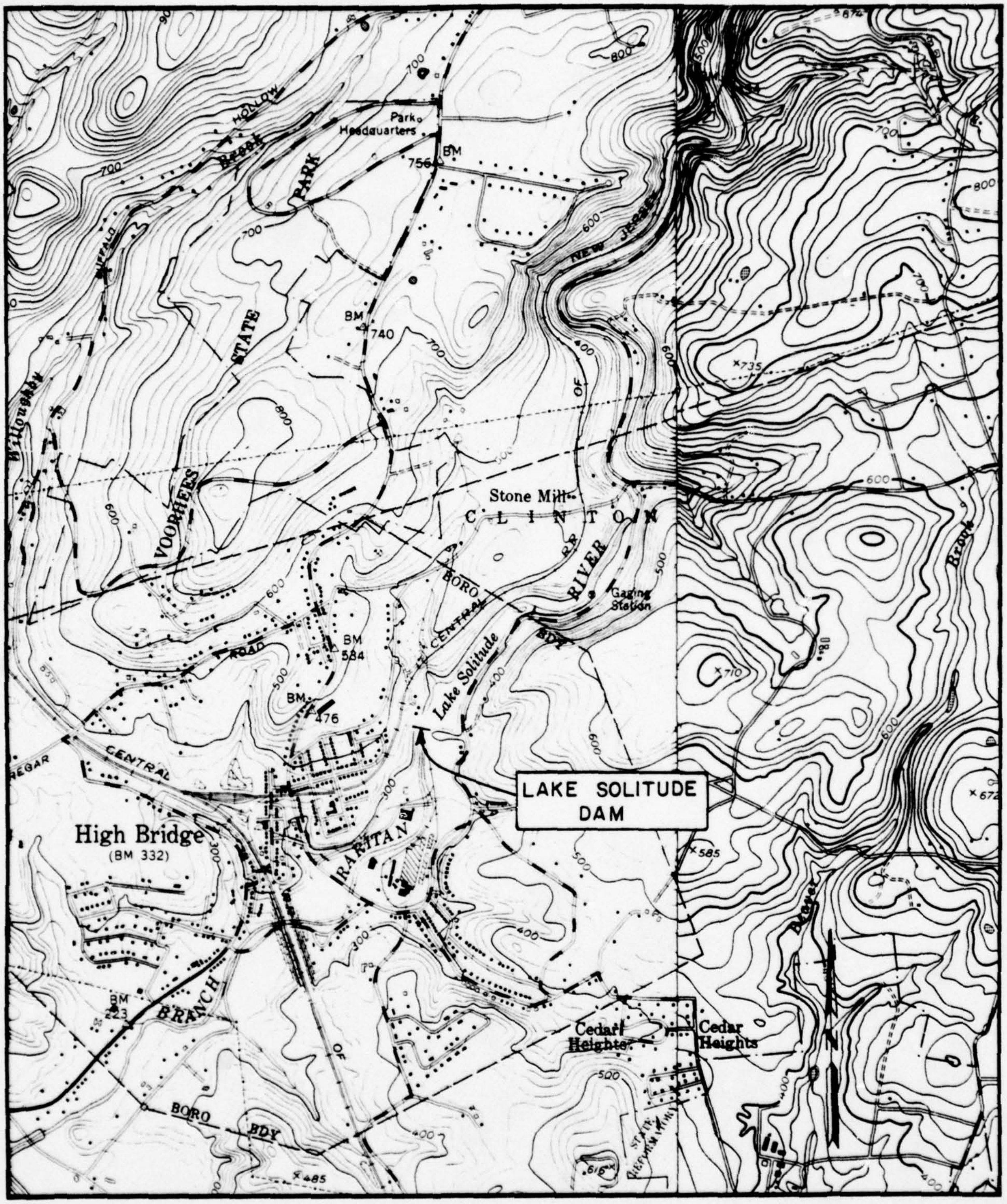
b. Operation and Maintenance Procedures

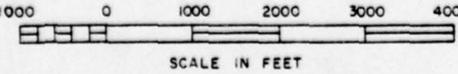
A program of inspections of the dam during and after floods and annually should be initiated by the owners, utilizing the standard visual checklist in this report.

Special attention should be given to monitoring the slope adjacent to the right abutment of the masonry dam. Remedial measures should be taken,should any significant movement of this slope appear imminent.

A permanent record should be kept of all maintenance and operating events of the dam and reservoir.

A warning system should be established whereby downstream inhabitants may be notified and evacuated in the event of possible dam failure.

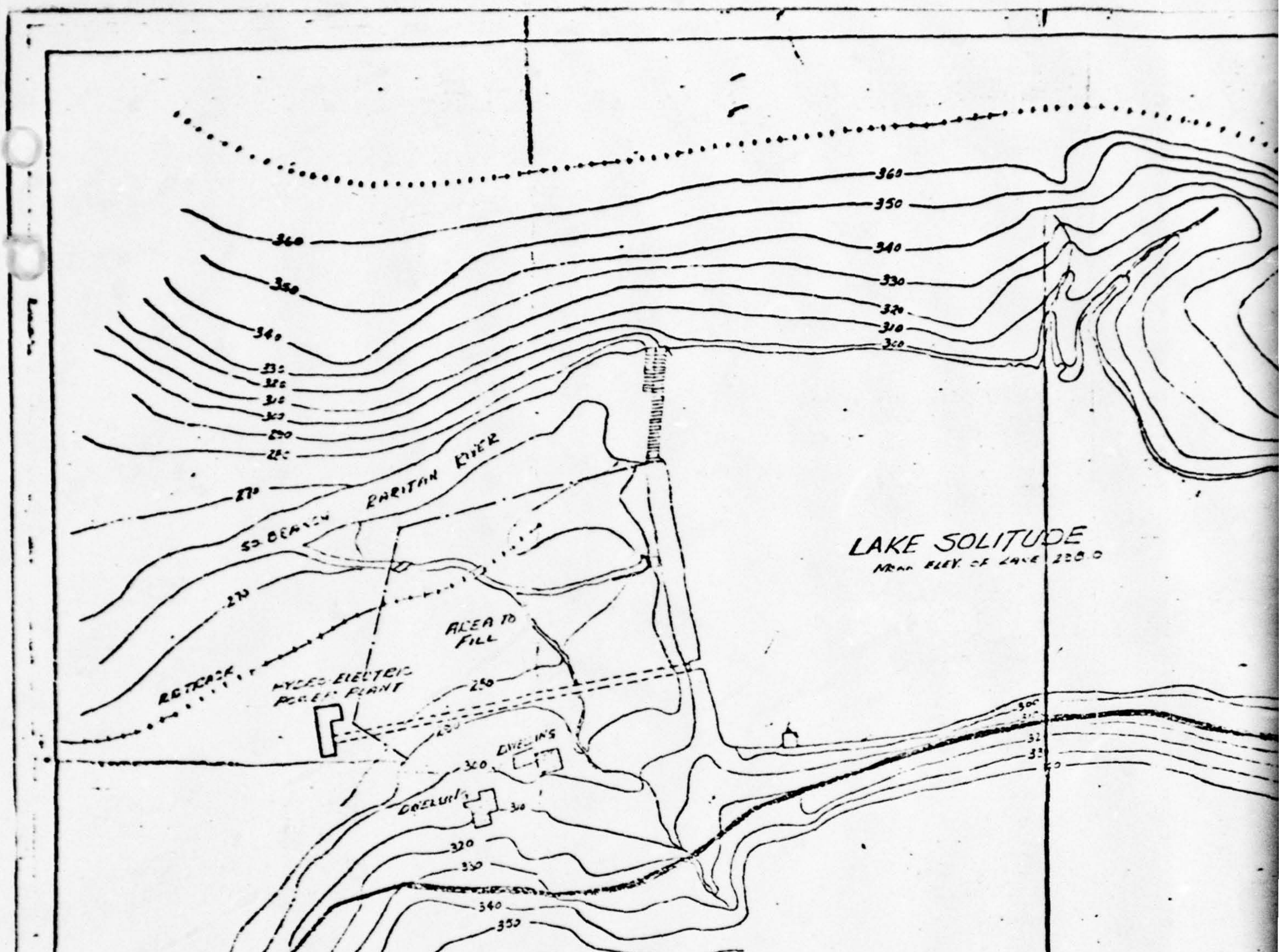




AREA LOCATION

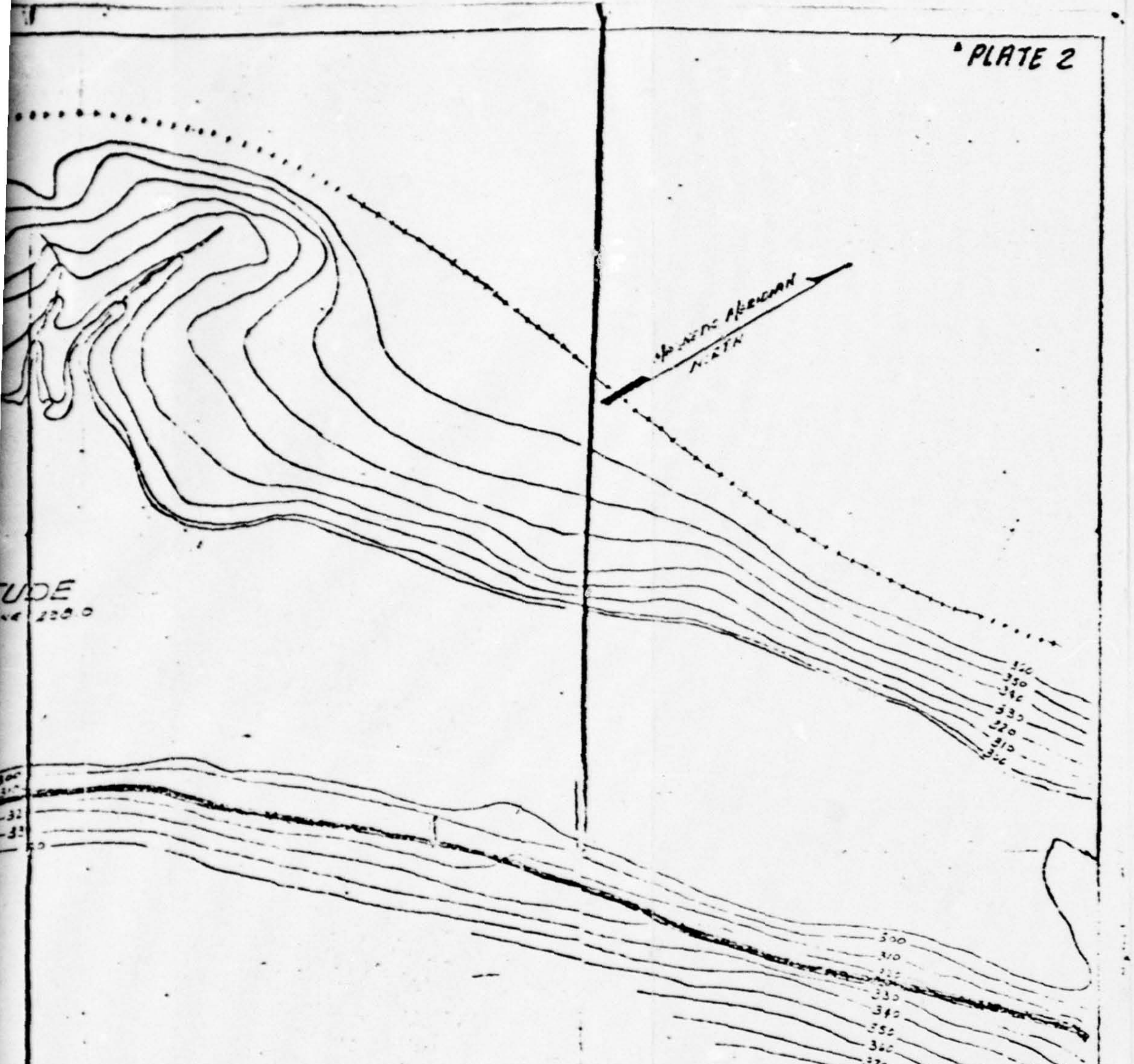
VICINITY MAP

JENNY-LEEDSHILL JANUARY 1979

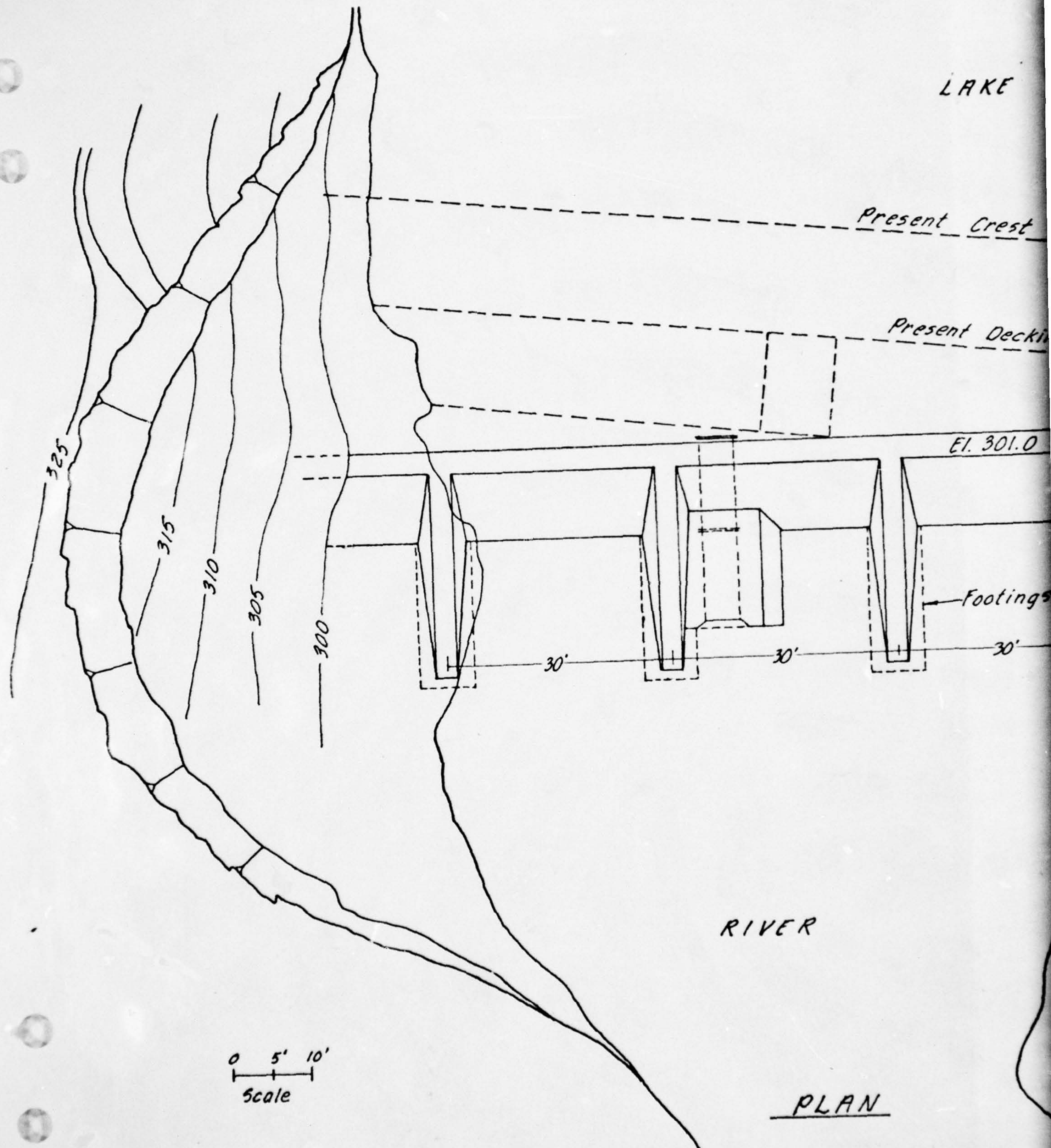


LAKE SOLITUDE
MEAN ELEV. OF LAKE 228.0
SO. BRANCH RARITAN RIVER
AREA TO FILL
HYDRO ELECTRIC POWER PLANT
RETRACK
DWELLINGS
DWELLING
ROAD WAY
360
350
340
330
320
310
300
290
280
270

PLATE 2



1" = 220'
TOPOGRAPHY SURROUNDING LAKE SOLITUDE
TAYLOR WHARTON I. & S. CO. HIGH BRIDGE, N.J.
SCALE 1" = 100' 1-3-55
TAKEN FROM
DWG. No 1402 BY F.S. TAINTER, C.E.
DATED OCTOBER, 1906
Sk. No 1313-A


LAKE
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RIVER
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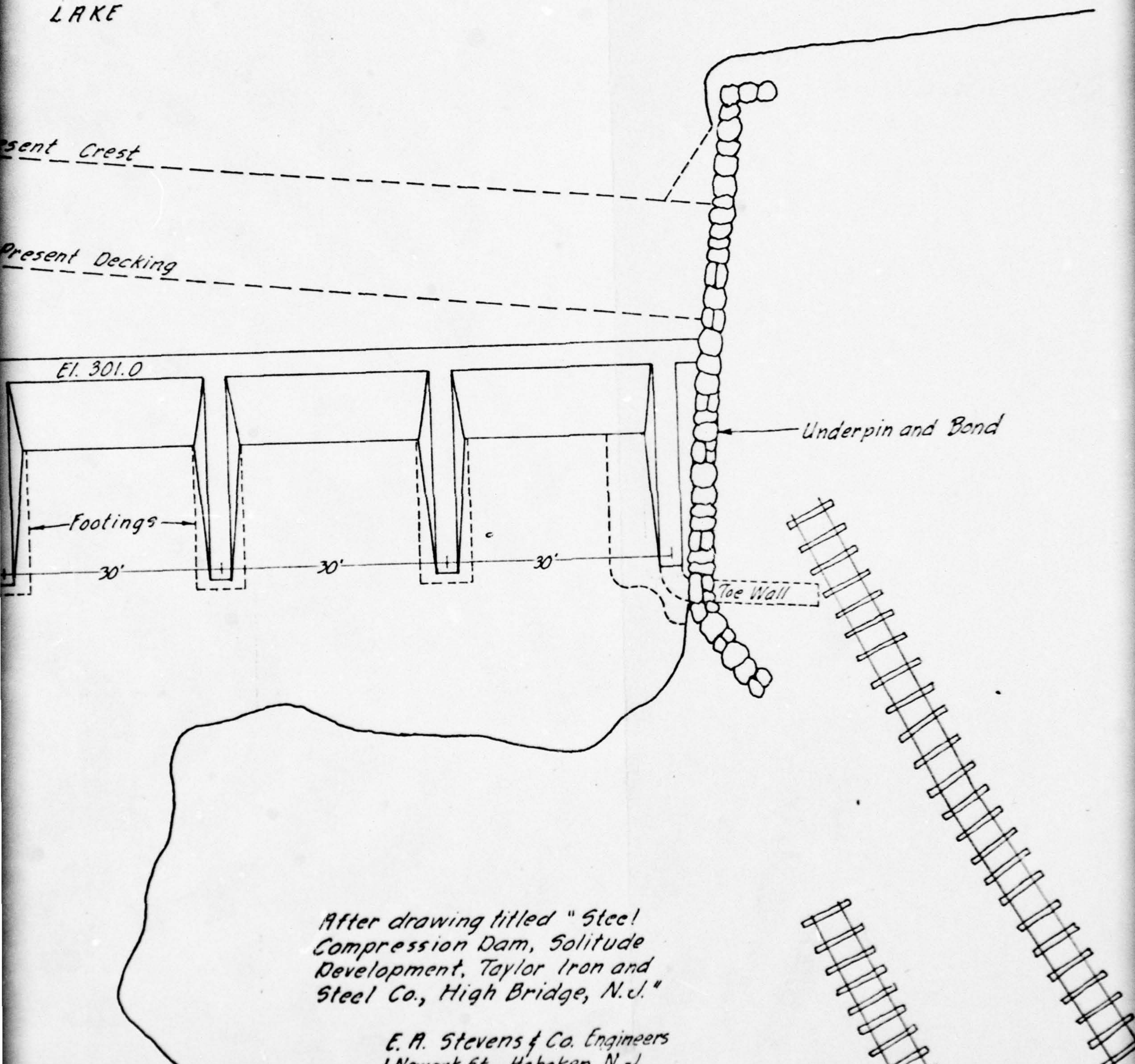
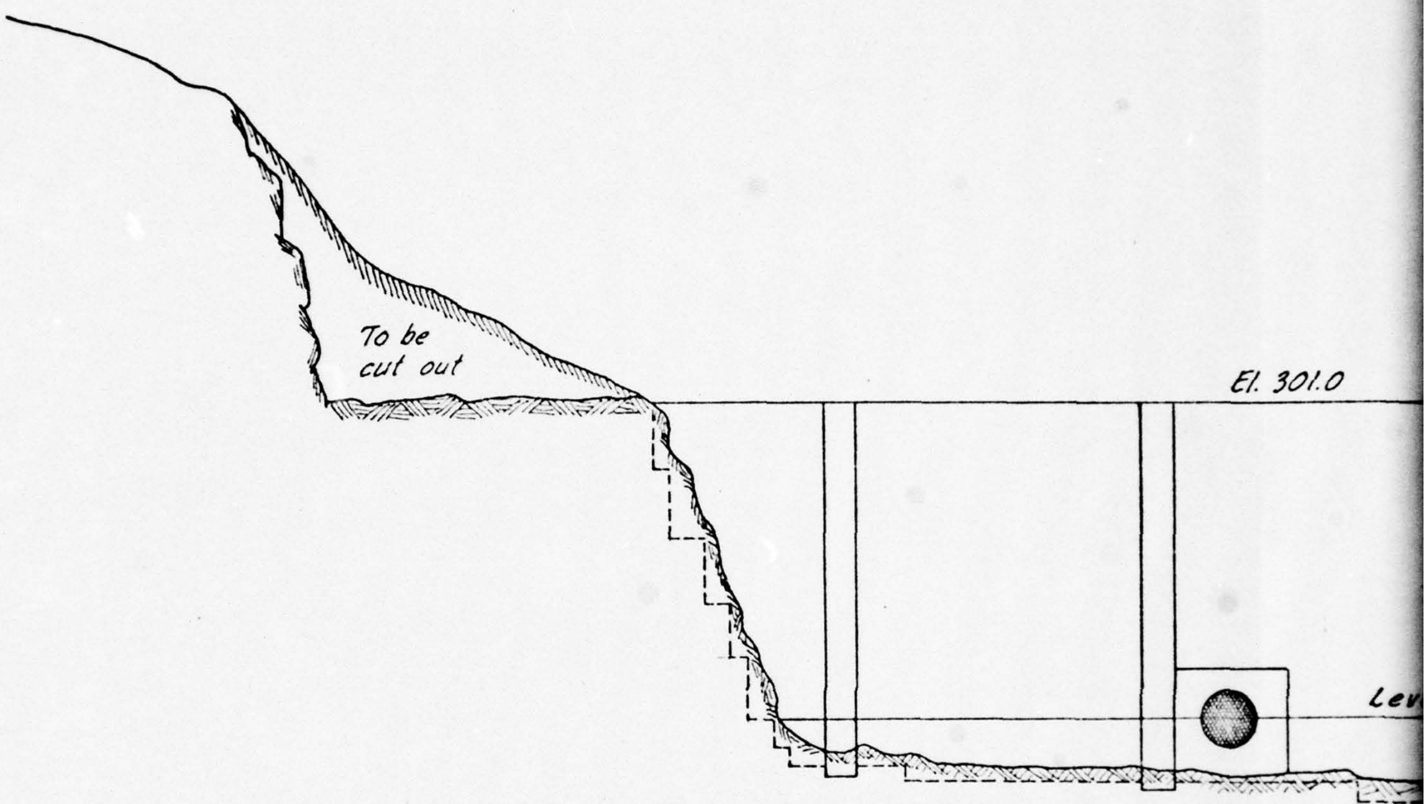
Scale

PLAN



After drawing titled "Steel Compression Dam, Solitude Development, Taylor Iron and Steel Co., High Bridge, N.J."

E. A. Stevens & Co. Engineers
1 Newark St, Hoboken N.J.
Corrected September 14, 1909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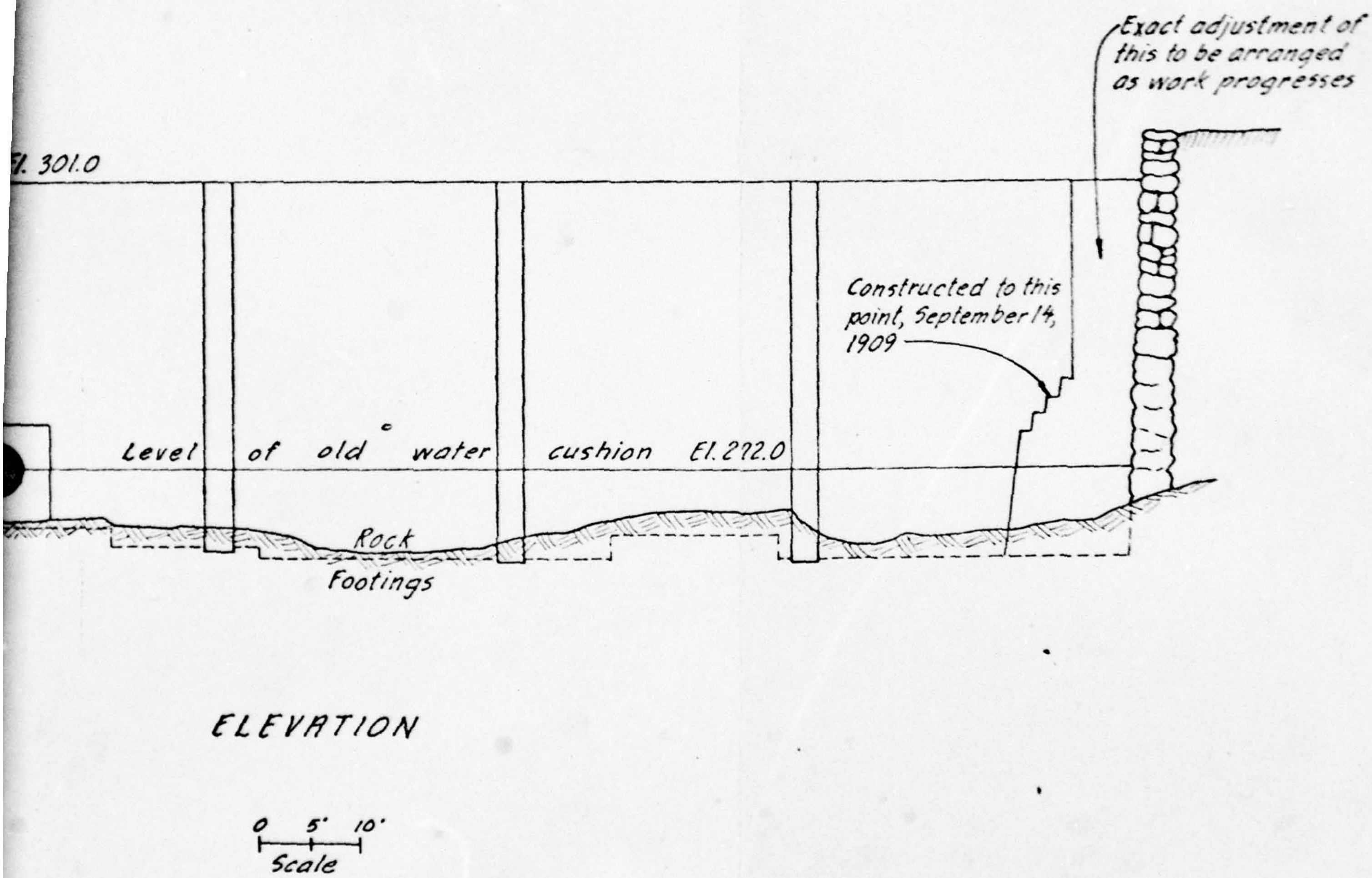
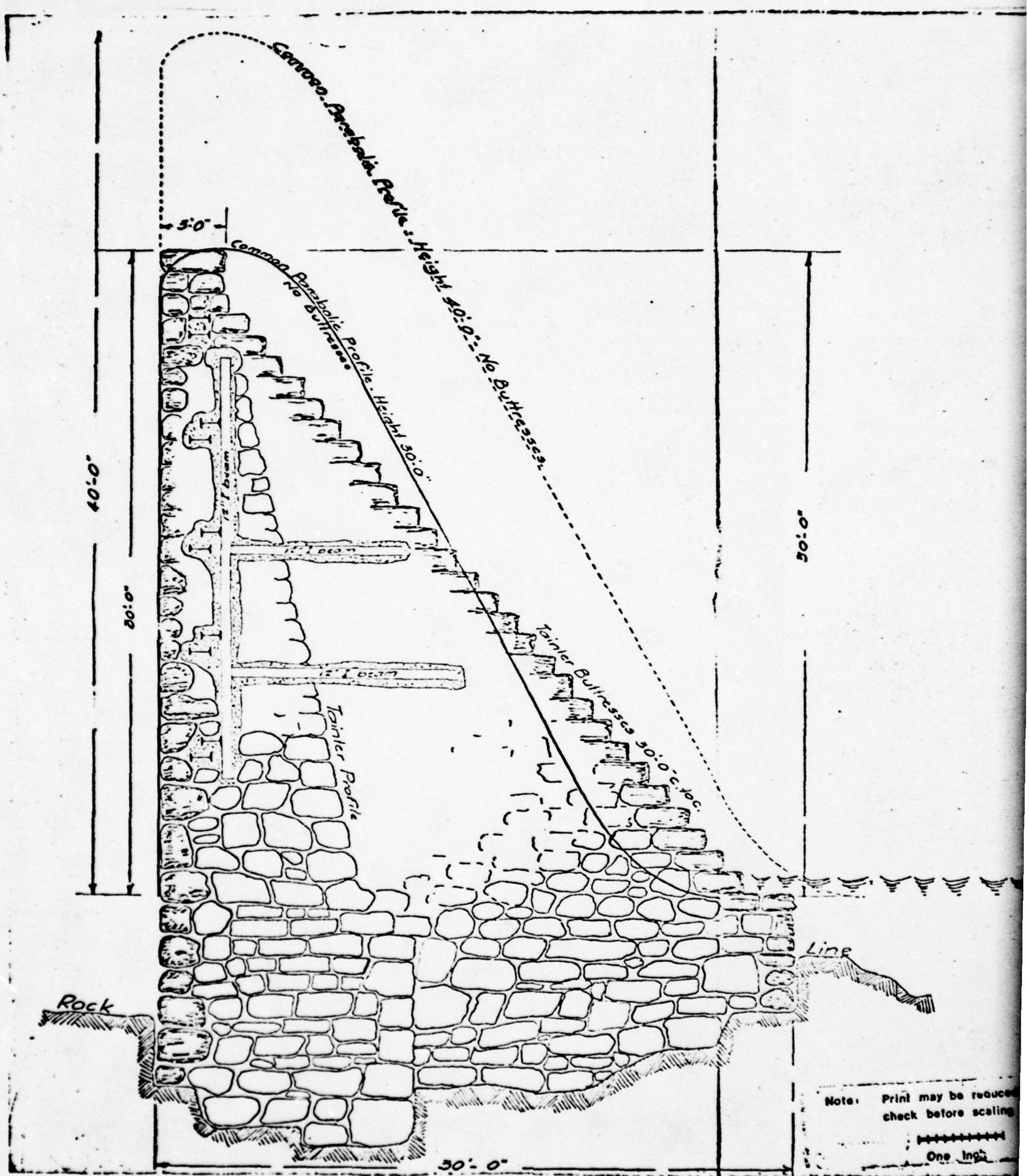


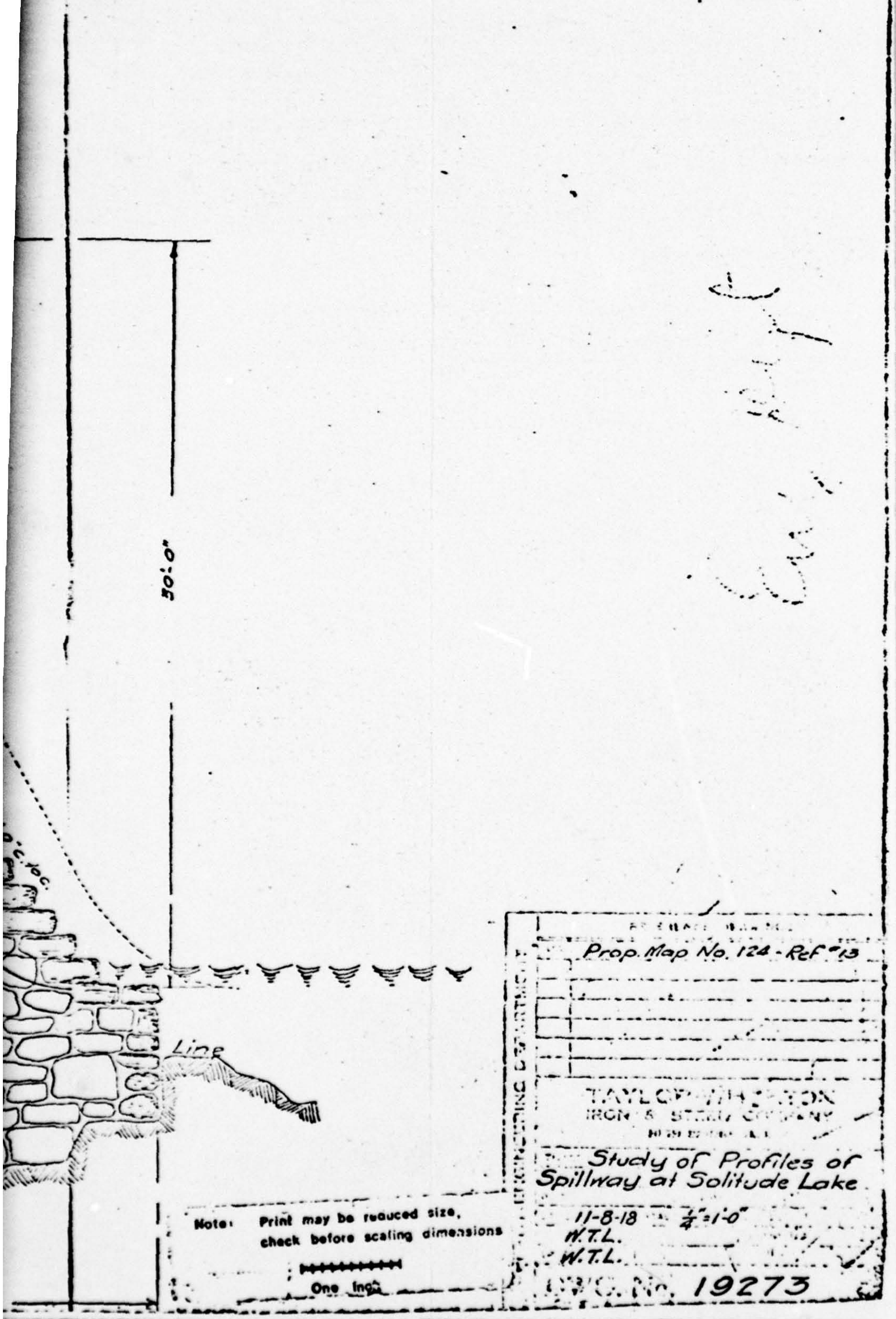
After drawing titled
" TISCO No. 12"

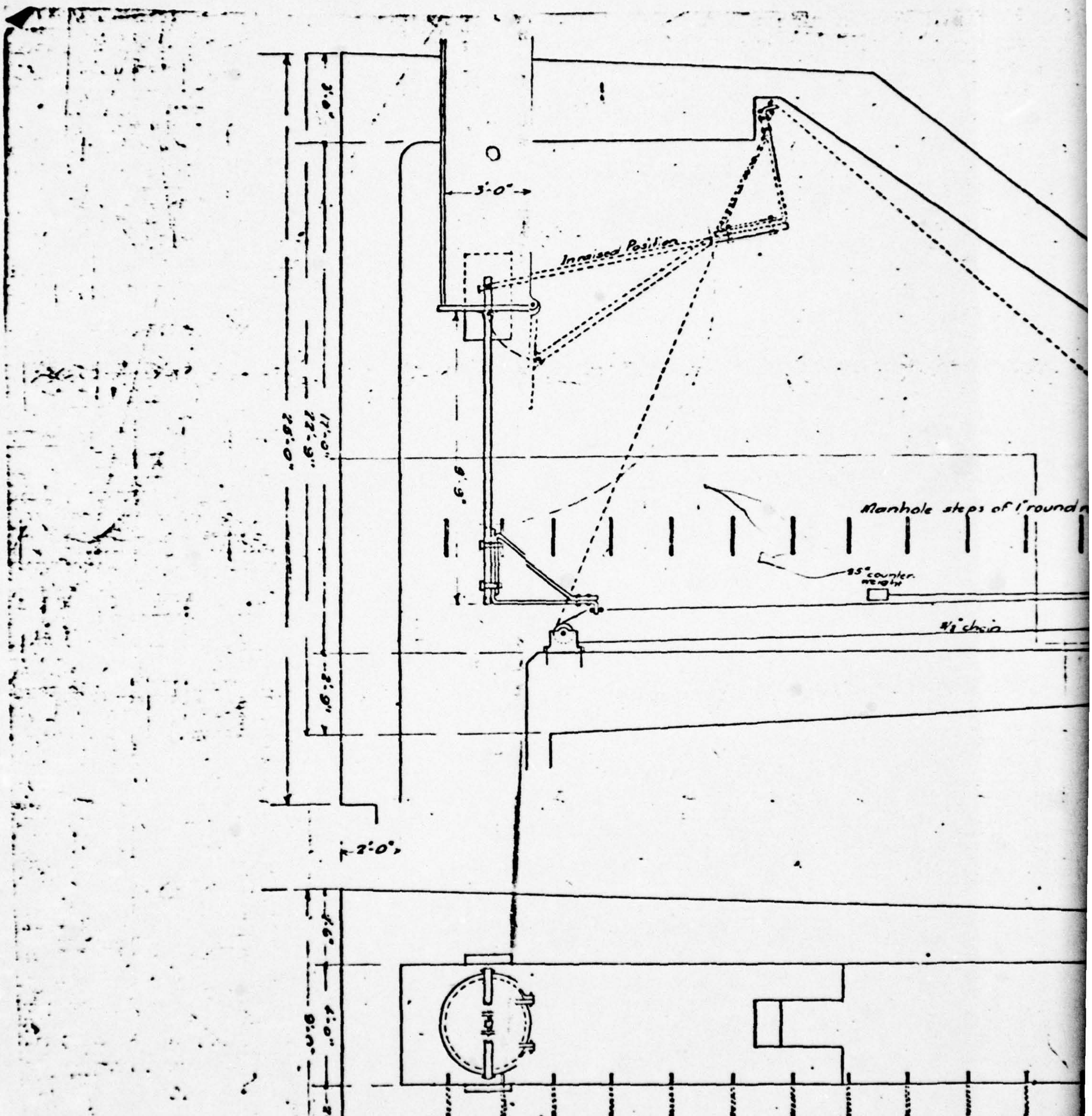
E. A. Stevens & Co. Engineers
1 Newark St., Hoboken N. J.
Corrected September 14, 1909



Common Parabolic Profile ; Height 40'0" ; No Buttresses.
Common Parabolic Profile Height 30'0"
No Buttresses
Tainter Buttresses 30'0" c. to c.
Tainter Profile
12" beam
12" beam
12" beam
5'0"
40'0"
30'0"
30'0"
30'-0"
Rock
Line
Note: Print may be reduced
check before scaling
One Inch

PLATE 5

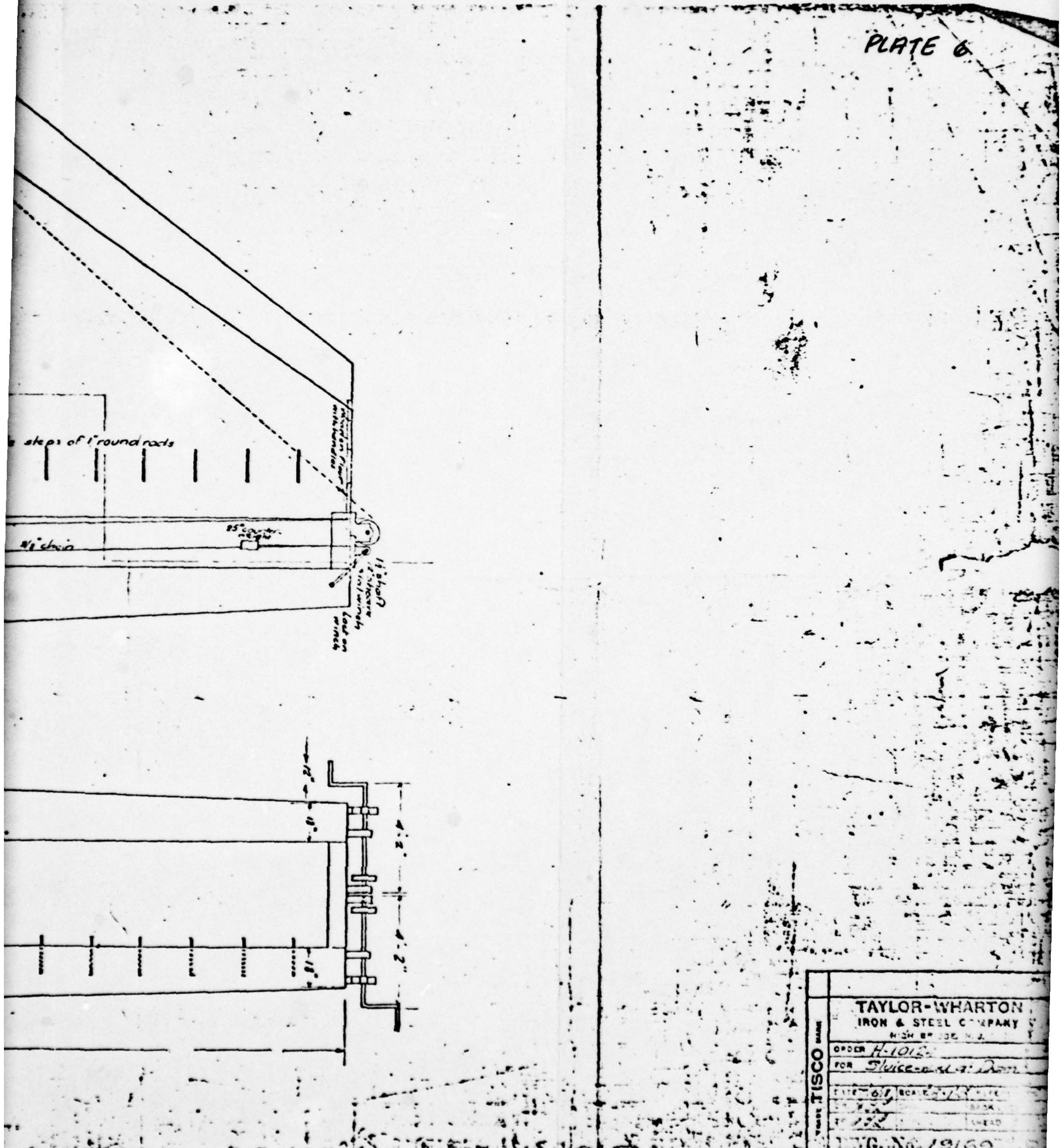

30'-0"
Line
Prop. Map No. 124 - Ref. #13
TAYLOR-WHARTON
IRON & STEEL COMPANY
Study of Profiles of Spillway at Solitude Lake
11-8-18
1/4" = 1'-0"
W.T.L.
W.T.L.
DWG. No. 19273
Note: Print may be reduced size, check before scaling dimensions
One Inch



REF.	DATE	APP.	AUTHORITY

REVISIONS

PLATE 6


steps of 1" round rods
85° counter-weight
chain
Wooden floor with handles
Load on winch
TAYLOR-WHARTON
IRON & STEEL COMPANY
TISCO
ORDER H-1012
DWG. No. 19169

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION
MAINTENANCE DATA

Check List
Visual Inspection
Phase 1

Name Dam Lake Solitude **County** Hunterdon **State** New Jersey **Coordinators** NJDEP

Coordinates: Lat. 40° 47' 22"
Long. 74° 53' 18" N

Date(s) Inspection Dec. 4 & 21, 1978 **Weather** Overcast Light rain **Temperature** 55° f

Pool Elevation at Time of Inspection 301.33 ft. M.S.L. **Tailwater at Time of Inspection** 270 ft. **M.S.L.** (Approx.)

Inspection Personnel:

(Dec. 4, 1978)	(Dec. 21, 1978)	
R. C. Gaffin	R. J. Jenny	
A. R. Slaughter	D. J. Lachel	
P. L. Wagner	F. L. Panuzio	
	A. R. Slaughter	

R. C. Gaffin **Recorder**

CONCRETE/MASONRY DAMS

Lake Solitude Dam

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	None observed, but observation limited due to water flowing over dam.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	-Potential slide area at cut in right abutment and possible local surfaced slips. -Right abutment appears to be founded on rock, but could not be closely observed due to water flowing over dam. -Left abutment bears against a cemented masonry retaining wall. This junction	was also obscured by water flowing over the dam. -Junction between cemented masonry retaining wall and embankment appears in good condition with no signs of settlement or cracking.
DRAINS	None	
WATER PASSAGES	-Entire masonry section of dam acts as the spillway. -Outlet conduit and gate controls located on the right third of the dam were inaccessible for inspection.	
FOUNDATION	Plans indicate that the entire foundation bears on rock. Much of the foundation could not be observed. Bedrock exposed at right abutment dipping towards reservoir and slightly downstream.	

CONCRETE/MASONRY DAMS

Lake Solitude Dam

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	None observed. Concrete mortar and concrete cap on spillway sill appears in good condition.	
STRUCTURAL CRACKING	None observed.	
VERTICAL AND HORIZONTAL ALIGNMENT	No indication of vertical or horizontal misalignment.	
MONOLITH JOINTS	None	
CONSTRUCTION JOINTS	Mortar is in good condition with minor local spalling. Blocks are cut granite approximately 1'x1'x3'.	

NOTE: The observations below refer to the earth embankment located to the left of the masonry dam. The limits of the natural and man-made portions of this embankment are not known.

Lake Solitude Dam

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	-None observed -A road extends along the downstream toe of embankment.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Embankment surface and slopes are irregular. Local sloughing on downstream slope.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Gently sloping upstream slope, steep downstream slope and undulating surface. Embankment becomes wider as it approaches the masonry section.	
RIPRAP FAILURES	No riprap observed.	

EMBANKMENT

Lake Solitude Dam

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Grass and brush on upstream face and crest. Moderately heavy growth of small trees and brush on downstream slope.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Minor erosion at left junction of embankment and spillway, but no noticeable settlement or cracking. In part due to newly constructed staircase down side of embarkment to river.	
ANY NOTICEABLE SEEPAGE	None observed	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

Lake Solitude Dam

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Visable section of tunnel which passes through right third of embankment appears to be in good condition.	
INTAKE STRUCTURE	Intake to penstock is severely silted and congested with debris. Intakes to outlet on right third of masonry structure and horseshoe tunnel through right third of embankment were not accessible for inspection.	
OUTLET STRUCTURE	Approximately 10 gpm. passing out of 4.5 ft. wide by 3.3 ft. high horseshoe shaped tunnel of unknown purpose. A jet of water was leaking out of the abandoned 6 ft. diameter penstock where it goes underground to connect to power plant.	
OUTLET CHANNEL	Discharge from tunnel passes through masonry wall lined channel approximately 5 feet wide and 3 feet high and flows into natural channel downstream of dam. 6 ft. diameter penstock and turbine have been abandoned.	
EMERGENCY GATE	Outlet located at right side of masonry dam was inaccessible for inspection.	

UNGATED SPILLWAY

Note: Entire length of masonry dam acts as an ungated spillway.

Lake Solitude Dam

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Concrete sill in good condition.	
APPROACH CHANNEL	None	
DISCHARGE CHANNEL	Natural stream channel cut to bedrock at toe of dam. Stilling basin extends approximately 100 ft. downstream and tappers into natural stream channel.	
BRIDGE AND PIERS	None	

GATED SPILLWAY
(None)

Lake Solitude Dam

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not Applicable	
APPROACH CHANNEL	Not Applicable	
DISCHARGE CHANNEL	Not Applicable	
BRIDGE AND PIERS	Not Applicable	
GATES AND OPERATION EQUIPMENT	Not Applicable	

INSTRUMENTATION

Lake Solitude Dam

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	Weir noted approximately 0.6 miles upstream from dam.	
PIEZOMETERS	None	
OTHER	None	

RESERVOIR

Lake Solitude Dam

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Generally steep, wooded slopes. Section of slope above right abutment has been excavated into rock. Possible surficial soil slide on right abutment just downstream of dam.	
SEDIMENTATION	Water is clear. Visibility to about 4 ft. below surface.	June, 1978 inspection report indicates that silting is a problem.

DOWNSTREAM CHANNEL

Lake Solitude Dam

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Few logs in stream. Relatively steep gradient with some minor rapids.	
SLOPES	Right bank steep and wooded. Left bank gentle and wooded.	
APPROXIMATE NO. OF HOMES AND POPULATION	Railroad and road bridge, closed steel mill and approximately 12 houses 1/4 to 1/2 mile downstream within the flood plain; 2 houses on left bank approximately 300 feet downstream of earth embankment	

Sheet 1

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Lake Solitude Dam

ITEM	REMARKS
PLAN OF DAM	(1) "Steel Compression Dam" plans & section, 4 sheets, F . S. Tainter, Engineer, 1909. (2) "Steel Compression Dam, Solitude Development, Taylor Iron & Steel Co., High Bridge, N.J." Plan and Elevation Stevens & Co. Engineers, corrected Sept. 14, 1909. (Plates 3 and 4)
REGIONAL VICINITY MAP	(1) "Contour map of a portion of the valley of south branch immediately above the plant of, The Taylor Iron & Steel Company, High Bridge, New Jersey" E. A. Stevens & Co., Engineers, March, 1909. (2) "Topography Surrounding Lake Solitude" drawing No. 1919-A, Taken from Dwg. No. 1402 by F. S. Tainter, C.E., dated October, 1906 - (Plate 2)
CONSTRUCTION HISTORY	"Dams in New Jersey - Reference Data No. 24-57" dated 1/4/26 gives construction date of December 1909.
TYPICAL SECTIONS OF DAM	(1) See 'Plan of Dam' (2) 'Compression Dam Section Sheet', dated 10-12-38. (3) Study of Profiles of Spillway at Solitude Lake; Dwg. No. 19273, dated 11-8-18. (Plate 5)
HYDROLOGIC/HYDRAULIC DATA	See 'Typical Section of Dam' item 3.
OUTLETS - PLAN	See 'Plan of Dam'
- DETAILS	Section and operating equipment shown on 'Sluice at Dam' Dwg. No. 19169, dated 7/16/18. (Plate 6)
-CONSTRAINTS	None known
-DISCHARGE RATINGS	Not Available.
RAINFALL/RESERVOIR RECORDS	None

Sheet 2

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Lake Solitude Dam

ITEM	REMARKS
DESIGN REPORTS	None
GEOLOGY REPORTS	None
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	 Parabolic profile of discharge of spillway shown on "Study of Profiles of Spillway at Solitude Lake"; Dwg. No. 19273, dated 11-8-18 (Plate 5) None None
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES	Not Known

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Lake Solitude Dam

ITEM	REMARKS
SPILLWAY-PLAN -SECTIONS -DETAILS	See 'Plan of Dam' and 'Typical Sections of Dam'
OPERATING EQUIPMENT PLANS & DETAILS	See Outlets
MONITORING SYSTEMS	None
MODIFICATIONS	None
HIGH POOL RECORDS	None
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Dam Inspection Report, June 2, 1978, prepared by John Garofalo dated August 7, 1978.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Lake Solitude Dam

ITEM	REMARKS
MAINTENANCE OPERATION RECORDS	None

APPENDIX B

PHOTOGRAPHS

(Note: All photographs were taken on Dec. 4, 1978)

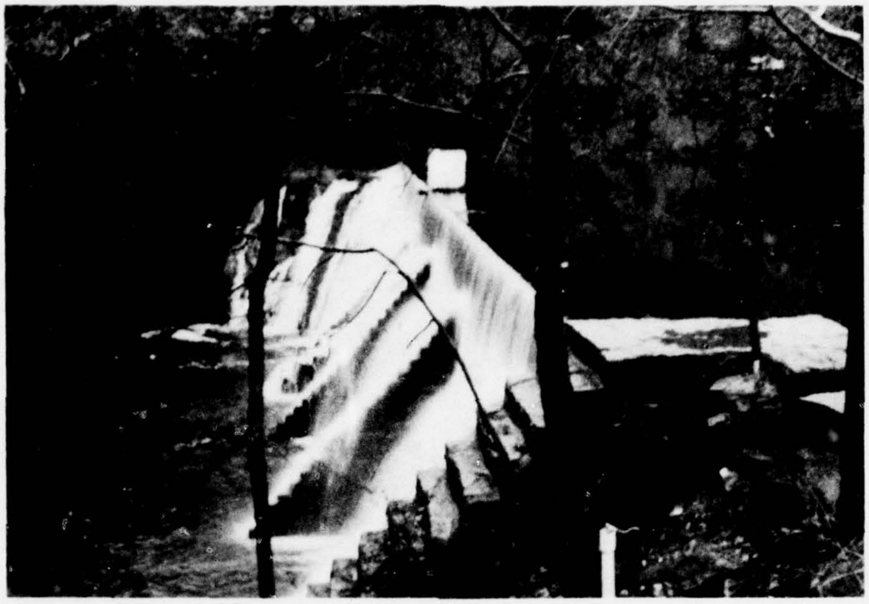


Photo 1 View of masonry dam from left abutment

Photo 2 View of right abutment of masonry dam
looking upstream

Photo 3 View of upstream face of embankment looking east

Photo 4 View of downstream face of embankment looking east

Photo 5 View of tunnel outlet channel looking upstream

Photo 6 View of intake to penstock

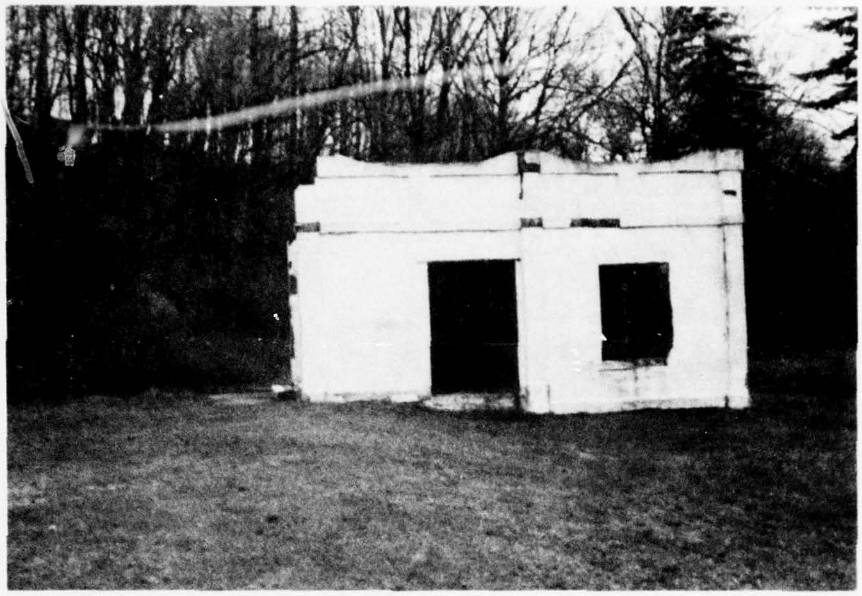


Photo 7 View of hydro-electric power plant with penstock at left

Photo 8 View of penstock showing leak (arrow)

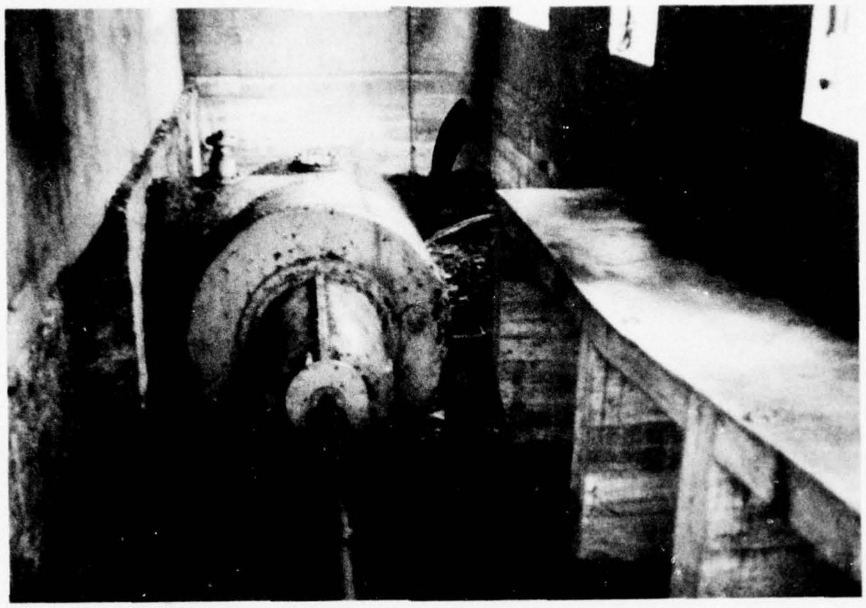


Photo 9 View of turbine inside power house showing leak (arrow)

Photo 10 View of reservoir looking upstream

Photo 11 View showing training wall on left bank of downstream channel

Photo 12 View of downstream channel looking downstream

APPENDIX C

REGIONAL GEOLOGY - HIGHLANDS PROVINCE

REGIONAL GEOLOGY - HIGHLANDS PROVINCE

Physiography

The New Jersey Highlands extend northeast-southwest across the state from the New York border to the Delaware River. Included in the province are the northwest portions of Hunterdon, Passaic and Morris Counties and the southeastern portions of Warren and Sussex Counties. This province lies between the Appalachian Ridge and Valley Province to the northwest and the Piedmont Lowlands Province to the southeast (See Figure C-1) and is part of the larger New England Physiographic Province.

The Highlands are characterized by rounded and flat-topped northeast-southwest ridges and mountains up to 1,400 feet high separated by narrow valleys. The orientation of the valleys is usually, but not always, controlled by the underlying geologic structure.

Bedrock

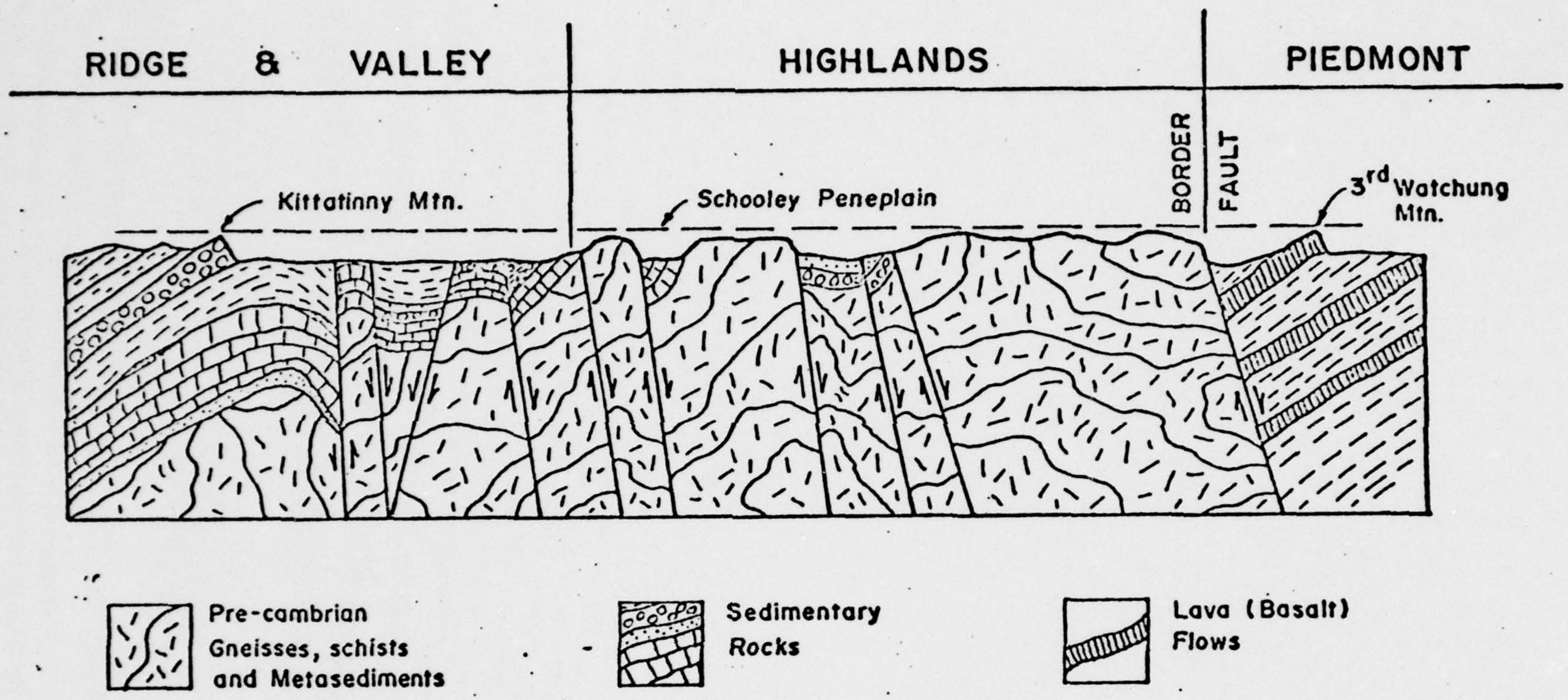
Bedrock of the region is predominently Precambrian gneisses, schists and metasediments. Some sedimentary rocks, typically sandstones, shales and conglomerate have been infolded and infaulted into the valley bottoms.

The regional geologic structure reflects the very old age of bedrock. A number of regional faults cross the area in a northeast-southwest direction. The Ramapo Fault scarp, forming the eastern border of the province, is more than 30 miles long. Faults also control many of the river valley orientations.

Mountain crests slope uniformly from northwest to southwest, a direct result of the fact that the entire area was once part of the now dissected Schooley peneplain.

Overburden

Much of the province was covered by the Pleistocene age Wisconsin glacier. The glacier stripped most of the existing overburden and weathered rock and uncovered the numerous hard bedrock knobs and ridges seen throughout the province. Most of the side-slopes in the area are covered with heavy boulder tills (ground moraine), while glacial outwash and recent alluvium cover the valleys. South of the terminal moraine extending from Morristown to Belvidere, scattered remnants of earlier stages of glaciation (Illinoian and Kansan) have deposited ground moraine (glacial tills) over the bedrock. In the valleys and over some of the ground moraine, recent and glacio-fluvial alluviums have been deposited.



SCHEMATIC CROSS-SECTION OF
NEW JERSEY HIGHLANDS
PHYSIOGRAPHIC PROVINCE
(AFTER WOLFE, 1977)

JENNY/LEEDSHILL
JANUARY 1979

FIGURE C-1

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

LAKE SOLITUDE

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 65.3 SQ MI.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 301 FT (540 AF)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 305.7 FT (700 AF)

ELEVATION MAXIMUM DESIGN POOL: 313.8 FT

ELEVATION TOP DAM: 305.7 FT

CREST: SPILLWAY

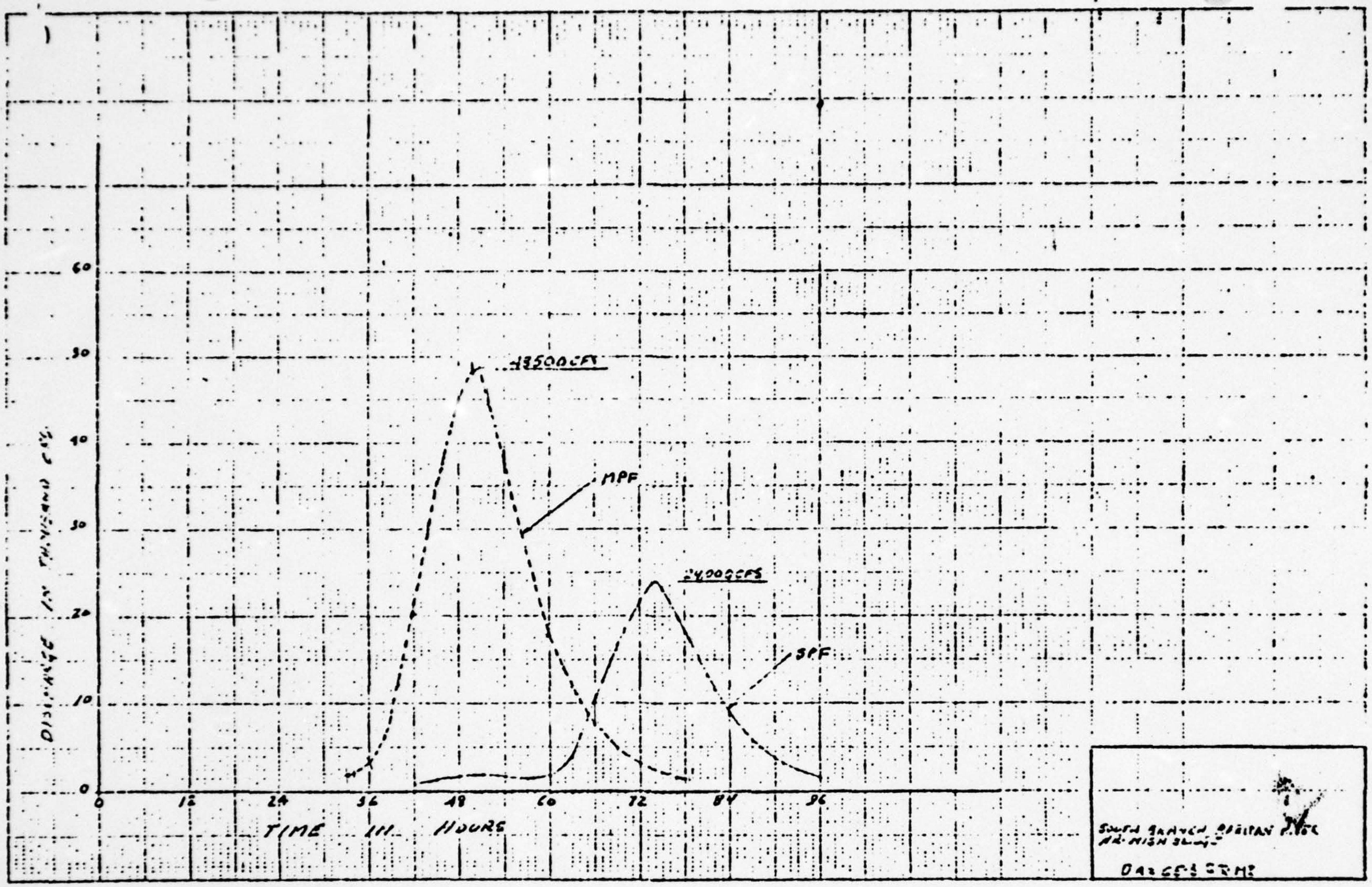
a. Elevation 301 FT
b. Type MASONRY OVERFLOW
c. Width 4 FT
d. Length 210 FT
e. Location Spillover RIGHT ABUTMENT (ENTIRE MASONRY SECTION)
f. Number and Type of Gates NONE

OUTLET WORKS: 3-OUTLETS - FROM FIELD INSPECTION ALL APPEAR INOPERABLE

a. Type
b. Location
c. Entrance inverts
d. Exit inverts
e. Emergency draindown facilities

HYDROMETEOROLOGICAL GAGES: NONE
a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 7000 CFS



USE FOR Lake Solitude (N.J. 00123)

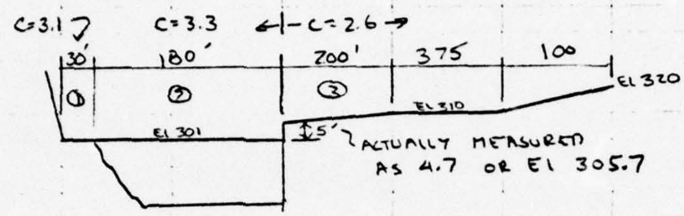
123

PLATE I

LEEDS, HILL AND JEWETT, INC.

BY RBE DATE 790129 CLIENT N. J. SHEET NO. ____ OF ____

CHKD ____ DATE ____ JOB LAKE SOLITUDE JOB NO. 302-07



$Q = CLH^{1.5}$

CONTOUR	SECTION ① H_1 (FT)	Q_1 (CFS)	SECTION ② H_2 (FT)	Q_2 (CFS)	SECTION 3 H_2 (FT)	Q_2	Q
301	0	0	0	0	0	0	0
306	5	1040	5	6640		0	7680
308	7	1720	7	11000	2	285	13005
310	9	2510	9	16040	4	1650	20200
312	11	3390	11	21670	6	7100	32160
315	14	4870	14	31115	9	20850	56835
305.7	4.7	950	4.7	6050	0	0	7000
303	2	260	2	1680	0	0	1940
305	4	740	4	4750	0	0	5490

EXAMPLE: CONTOUR EL. 308

$Q = 3.1(30)(7)^{1.5} + 3.3(180)(7)^{1.5} + \left(\frac{200}{310-306}\right)2.6(1.5)^{1.5} + \left(\frac{200}{310-306}\right)2.6(0.$

$Q = 1720 + 11000 + 240 + 45$

$Q = 13005$ CFS

@ EL 305.7

$Q = 3.1(30)(4.7)^{1.5} + 3.3(180)(4.7)^{1.5} = 7000$ CFS

LAKE SOLITUDE

LEEDS, HILL AND JEWETT, INC.

BY RBK DATE 7/01/78 CLIENT New Jersey SHEET NO. ___ OF ___

CHKD ___ DATE ___ JOB ___ JOB NO. 302-01

LAKE SOLITUDE

CHANNEL CROSS-SECTIONS ℄

STATION	DISTANCE DOWNSTREAM OF DAM (FT)	MANNINGS "n" LEFT OVER-BANK	MANNINGS "n" MAIN CHANNEL	MANNINGS "n" RIGHT OVER-BANK	CHANNEL INVERT (FT)	MAX ELEV. (FT)	REACH LENGTH (FT)	ENERGY GRADE LINE SLOPE	X OR Y	X or Y (FT) 1	2	3	4	5	6	7	8
3 - BELOW DAM	1300	0.10	0.35	0.10	253	280	1300	0.006	X	0	100	600	600	675 ~~650~~	675 650	700	1200
									Y	280	260	256	253	253	256	260	280
4	2670	0.10	0.35	0.10	243	280	1300	0.006	X	0	100	600	600	685	685	950	1800
									Y	280	260	246	243	243	246	260	280

℄ LOOKING UPSTREAM

½ SEE SHEET FROM VERTI. CHOW

D-5

D-6

Table 5-6. Values of the Roughness Coefficient n (continued)

Type of channel and description	Minimum	Normal	Maximum
C. Excavated or Dredged			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035
5. Stony bottom and weedy banks	0.025	0.035	0.040
6. Cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140
D. Natural Streams			
D-1. Minor streams (top width at flood stage <100 ft)			
a. Streams on plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2. Same as above, but more stones and weeds	0.030	0.035	0.040
3. Clean, winding, some pools and shoals	0.033	0.040	0.045
4. Same as above, but some weeds and stones	0.035	0.045	0.050
5. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150

STATIONS 3 & 4

Table 5-6. Values of the Roughness Coefficient n (continued)

Type of channel and description	Minimum	Normal	Maximum
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
2. Bottom: cobbles with large boulders	0.040	0.050	0.070
D-2. Flood plains			
a. Pasture, no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Dense willows, summer, straight	0.110	0.150	0.200
2. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
3. Same as above, but with heavy growth of sprouts	0.050	0.060	0.080
4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.120
5. Same as above, but with flood stage reaching branches	0.100	0.120	0.160
D-3. Major streams (top width at flood stage >100 ft). The n value is less than that for minor streams of similar description, because banks offer less effective resistance.			
a. Regular section with no boulders or brush	0.025	.....	0.060
b. Irregular and rough section	0.035	.....	0.100

OPEN-CHANNEL HYDRAULICS

STATIONS 3 & 4

VEN TE CHOW, Ph.D.

Professor of Hydraulic Engineering
University of Illinois

AD-A069 939 NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2
NATIONAL DAM SAFETY PROGRAM. LAKE SOLITUDE DAM (NJ00123), RARIT--ETC(U)
MAY 79 R J JENNY DACW61-78-C-0124

UNCLASSIFIED NL

2 OF 2
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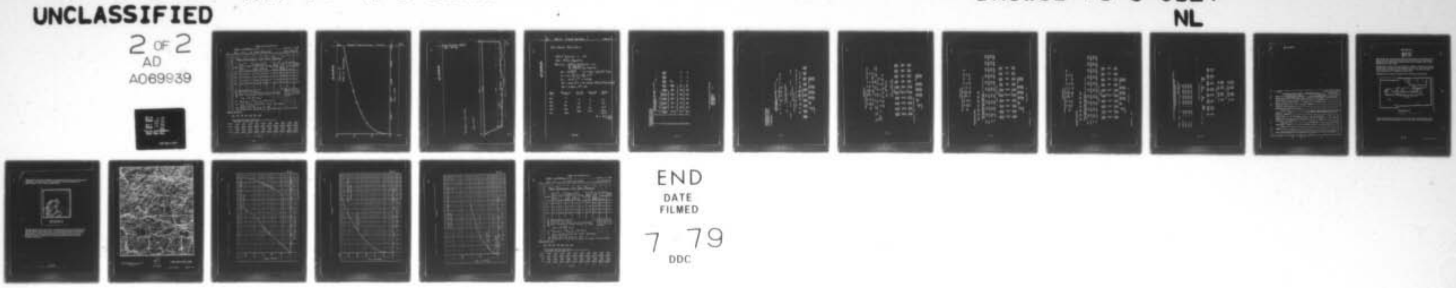
A069939



END
DATE
FILMED
7 79
DDC

Peak Discharge for Dam Breach [1]

% PMF	Max W.S.E.L No Breach [2]	Depth H (FT) [3]	Discharge No Breach (CFS) [2] Q_2 over dam	Discharge No Breach (CFS) Q @ STA 4	Q_4/Q_2	Flow Area @ 4/9 H (FT²) [4]	Q_B for Dam Breach (CFS) [5]	Q_B @ STA 4 (CFS) [6,10]	Stage Elev. @ STA 4
25	307.64	39.6	12030	12000	0.95	2870	68320	64900	262.7
50	310.66	42.7	24130	24030	0.95	3100	76630	72800	263.7
75	312.53	44.5	38710	36460	0.95	3240	81760	77670	264.2
100	313.81	45.8	48080	47890 [9]	0.95	3340	85510	81230	264.6

1. Instantaneous Failure
2. From HEC-1DB Run
3. W.S.E.L. - El. 268 (Bottom of avg section)
4. From Idealized Cross-Section of Dam
5. $Q_B = (2/3\sqrt{gH}\,A_{4/9})$
6. $Q_{B\,@\,STA\,4} = Q_{B\,@\,STA\,2}\,(Q_4/Q_2)$
7. From HEC1DB generated Stage Discharge Curve for Sta
8. Bottom Elev. @ STA 4 is 243
9. Corrected so that Q_4 is less than Q_2 (conservative)
10. Used an average attenuation of 0.95. Actual attenuation will be somewhat greater

NORMAL DEPTH CHANNEL ROUTING

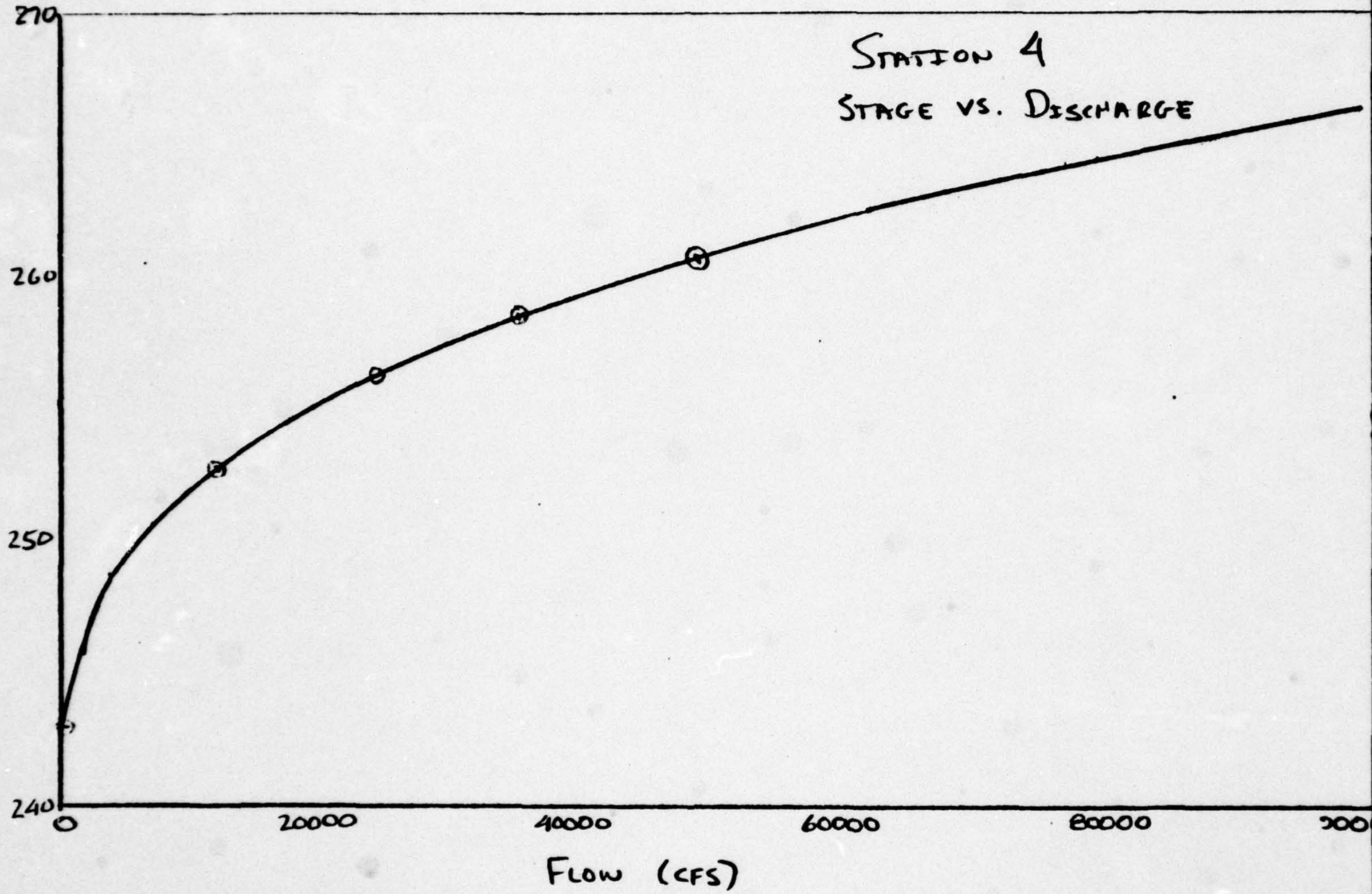
QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0450	.1000	243.0	280.0	1300.	.00600

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

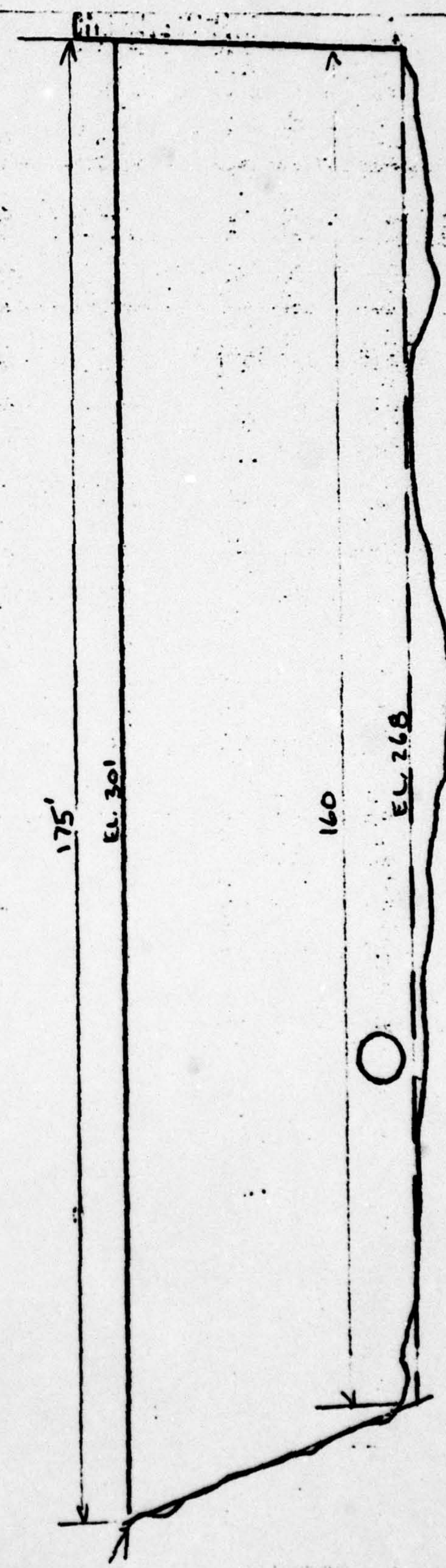
```
    0.00  280.00  100.00  260.00  400.00  244.00  600.00  243.00  675.00  243.00
  675.00  246.00  950.00  260.00 1800.00  280.00
```

STORAGE	0.00	4.36	9.36	19.75	36.38	59.28	88.45	123.88	159.57	213.10
	267.04	325.95	393.25	459.92	534.96	615.38	701.18	792.35	888.89	990.82
OUTFLOW	0.00	964.75	1775.76	3789.93	6904.42	11369.53	17403.17	25207.49	34972.53	46973.49
	61713.95	79079.40	99113.57	121901.59	147544.22	176139.67	207792.45	242626.82	280087.94	322140.37
STAGE	243.00	244.95	246.89	248.84	250.79	252.74	254.68	256.63	258.58	260.53
	262.47	264.42	266.37	268.32	270.26	272.21	274.16	276.11	278.05	280.00
FLOW	0.00	964.75	1775.76	3789.93	6904.42	11369.53	17403.17	25207.49	34972.53	46973.49
	61713.95	79079.60	99113.57	121901.59	147544.22	176139.67	207792.45	242626.82	280087.94	322140.37

RBF 790208 LAKE SOLITUDE 302-03 2/3



LAKE SOLITUDE 302-03
RBE 790208



FROM PLANS OF SEPT 14 1909

SCALE 1"= 16.5'

Draw Down Calculations

Outlet Diameter = 36"

Use Orifice Equation

Assume: Orifice Coefficient = 0.6
No tailwater
No inflows into reservoir

$Q = CA\sqrt{2gH}$, H = mean hydraulic head.

$Q = 0.6 \times (\frac{\pi}{4} 3^2) \times \sqrt{2g} \times H^{1/2}$

$Q = 34.04 H^{1/2} = \Delta S / \Delta t$

$\Delta t = .0294 \times H^{-1/2} \times \Delta S \times (43560 \text{ ft}^3/\text{AF}) \times (1/3600 \text{ sec/HR})$

$\Delta t = 0.356 \times \bar{H}^{-1/2} \times \Delta S$

Elev.	Storage AF	ΔS, AF	AVG H, ft	Δt, HRS.
264	0			
		10	3	2.1
270	10			
		75	11	8.0
280	85			
		165	21	12.8
290	250			
		290	31.5	18.4
301	540			

Σ = 41.3 hrs

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  25 SEP 78
**********************************
A1       NEW JERSEY DAM SAFETY - LAKE SOLITUDE  I.D. NO. 00123
A2       HYDRAULIC-HYDROLOGIC ANALYSIS   302-03
A3       PROBABLE MAXIMUM FLOOD                                 -RBE-
B      44       1       0       0       0       0       0       0       0       0
B1      5
J       1       4       1
J1   0.25     0.5    0.75     1.0
K       0       1                                       1
K1       INFLOW HYDROGRAPH STARTING AT HOUR 32
M      -1            65.3            65.3
M    1750    2330    2920    3960    4750    6600    9000   12000   16250   20500
M   29250   30000   34250   38500   41750   45000   46750   48500   46750   49000
M   41900   39000   34500   31000   27750   24500   21250   18000   16000   14400
M   12000   10000    8750    7500    6500    5500    5000    4500    3750    3000
M    2750    2500    2250    2000    1750    1500
K       1       2                                       1
K1          ROUTED FLOWS THROUGH LAKE SOLITUDE
Y                               1       1
Y1      1                                             540      -1
Y4    301     303     305     306     308     310     312     315
Y5      0    1946    5490    7680   13609   20260   32160   96835
$S      0      10      85     250     540     870    1340
$E    264     270     280     290     301     310     320
$$    301
$D    320     2.6     1.5       0
K       1       3                                       1
K1       CHANNEL ROUTING -MODIFIED PULS- STATION 2 TO 3
Y                               1       1
Y1      1
Y6   0.10   0.045    0.10     253     280    1300   0.006
Y7      0     290     100     260     603     256     660     253     675     253
Y7    679     256     700     260    1200     280
K       1       4                                       1
K1       CHANNEL ROUTING -MODIFIED PULS- STATION 3 TO 4
Y                               1       1
Y1      1
Y6   0.10   0.045    0.10     243     280    1300   0.006
Y7      0     280     100     260     600     246     600     243     675     243
Y7    675     246     950     260    1800     280
K      99
```

```
PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

      RUNOFF HYDROGRAPH AT          1
      ROUTE HYDROGRAPH TO           2
      ROUTE HYDROGRAPH TO           3
      ROUTE HYDROGRAPH TO           4
      END OF NETWORK
```

```
*************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  25 SEP 78
*************************************

RUN  DATED 01/30/79
     TIMED 17.34.44.

              NEW JERSEY DAM SAFETY - LAKE SOLITUDE  I.D. NO. 00123
              HYDRAULIC-HYDROLOGIC ANALYSIS   302-03
              PROBABLE MAXIMUM FLOOD                                  -RBE-

                                  JOB SPECIFICATION
          NO     NHR    NMIN    IDAY    IHR    IMIN   METRC    IPLT    IPRT   NSTAN
          60       1       0       0      0       0       0       0       0       0
                                 JOPER    NWT   LROPT   TRACE
                                     5      0       0       0

                          MULTI-PLAN ANALYSES TO BE PERFORMED
                              NPLAN= 1 NRTIO= 4 LRTIO= 1
          RTIOS=    .25    .50    .75   1.00

     *********      *********      *********      *********      *********

                              SUB-AREA RUNOFF COMPUTATION

            INFLOW HYDROGRAPH STARTING AT HOUR 32

                     ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                         1       0       0       0       0       0       1       0       0

                                    HYDROGRAPH DATA
            IHYDG   IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
               -1      9   65.30    0.00   65.30    0.00   0.000       0       0       0

                                   INPUT HYDROGRAPH
    1750.    2330.    2920.    3500.    4750.    6600.    9000.   12000.   16250.   20500.
   29250.   38000.   34250.   38500.   41750.   45000.   46750.   40500.   46750.   45000.
   41500.   38000.   34500.   31000.   27750.   24500.   21250.   18000.   16000.   14000.
   12000.   10000.    8750.    7500.    6500.    5500.    6000.    4500.    3750.    3000.
    2750.    2500.    2250.    2000.    1750.    1500.

                          PEAK   6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
                 CFS    40500.   45604.    30333.    17994.        825075.
                 CMS     1373.    1291.      859.      510.         23396.
              INCHES               6.50     17.28     19.61          19.61
                  MM             165.01    439.03    498.09         498.09
               AC-FT             22614.    60165.    60254.         60254.
           THOUS CU M            27894.    74213.    84190.         84190.
```

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HYDROGRAPH ROUTING

ROUTED FLOWS THROUGH LAKE SOLITUDE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	946.	-1

STAGE	301.00	303.00	305.00	306.00	308.00	310.00	312.00	313.00
FLOW	0.00	1940.03	5493.00	7600.00	13005.00	20200.00	32160.00	56035.00

CAPACITY=	0.	10.	85.	250.	540.	870.	1340.
ELEVATION=	264.	270.	280.	290.	301.	310.	320.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
301.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
320.0	2.6	1.5	0.

STATION 2, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

1828.	2080.	2807.	3344.	4309.	5719.	8285.	11860.	19349.	26003.
24769.	29569.	34873.	37473.	42064.	44334.	47002.	48066.	47292.	44039.
42088.	38646.	34941.	30826.	20388.	24986.	21711.	18296.	16217.	14265.
12206.	19397.	9084.	7745.	6601.	5718.	9766.	9666.	3833.	3229.
2757.	2581.	2300.	2065.	1840.	1619.				

STORAGE

609.	616.	631.	642.	664.	691.	732.	777.	823.	869.
966.	944.	984.	981.	1016.	1025.	1042.	1049.	1044.	1028.
1016.	984.	969.	954.	934.	904.	882.	851.	829.	810.
787.	760.	740.	724.	707.	690.	691.	678.	652.	640.
630.	627.	621.	616.	610.	601.				

STAGE

302.9	303.1	303.5	303.8	304.4	305.1	306.2	307.5	308.7	310.0
310.8	311.6	312.0	312.4	313.0	313.3	313.7	313.8	313.7	313.4
313.0	312.4	312.0	311.8	311.4	310.7	310.5	309.5	308.9	308.4
307.7	307.0	306.5	306.0	305.5	305.1	305.1	304.8	304.1	303.7
303.5	303.4	303.2	303.1	302.9	302.7				

PEAK OUTFLOW IS 48089. AT TIME 18.66 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	48090.	45604.	30356.	17963.	826316.
CMS	1361.	1291.	860.	509.	23399.
INCHES		6.50	17.30	19.62	19.62
MM		165.01	439.36	498.32	498.32
AC-FT		22613.	60211.	68291.	68291.
THOUS CU M		27893.	74269.	84235.	84235.

D-12

HYDROGRAPH ROUTING

CHANNEL ROUTING -MODIFIED PULS- STATION 2 TO 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0450	.1000	253.0	280.0	1300.	.00600

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 293.00 100.93 260.00 660.00 256.00 600.00 253.00 675.00 253.00
675.00 256.00 700.30 260.00 1200.00 280.00

STORAGE	0.00	3.19	6.36	12.67	26.03	48.49	75.38	103.67	133.77	165.68
	199.39	234.92	272.25	311.39	352.34	395.09	439.66	486.03	534.21	584.19
OUTFLOW	0.00	337.05	1644.78	2137.16	3972.05	6806.02	11390.30	17127.23	24021.10	32061.74
	41245.03	51974.70	63659.52	75711.64	89545.60	104577.65	120825.37	138307.29	157042.71	177051.49
STAGE	253.00	254.42	255.84	257.26	258.68	260.11	261.53	262.95	264.37	265.79
	267.21	269.63	270.05	271.47	272.89	274.32	275.74	277.16	278.58	280.00
FLOW	0.00	337.05	1644.78	2137.16	3972.05	6806.02	11390.30	17127.23	24021.10	32061.74
	41245.03	51974.70	63059.52	75711.64	89545.60	104577.65	120825.37	138307.29	157042.71	177051.49

STATION 3, PLAN 1, RTIO 4

OUTFLOW

3830.	1097.	3414.	2846.	4566.	5300.	8161.	11280.	15370.	19766.
24563.	29302.	34045.	37452.	41716.	44459.	46691.	48261.	47260.	45105.
42674.	38378.	34911.	31193.	28299.	24992.	21649.	18673.	16123.	14547.
12275.	10580.	9094.	7900.	6719.	5836.	5672.	9235.	3806.	3271.
2803.	2577.	2352.	2369.	1864.	1624.				

STOR

21.	7.	23.	18.	31.	38.	96.	79.	95.	115.
136.	155.	175.	185.	201.	213.	218.	224.	223.	213.
202.	189.	176.	162.	151.	138.	123.	110.	99.	91.
80.	71.	61.	55.	48.	41.	40.	36.	26.	21.
18.	16.	14.	12.	11.	10.				

STAGE

258.1	255.9	258.3	257.0	259.0	259.6	260.9	261.5	262.5	263.5
264.5	265.3	266.2	266.6	267.3	267.7	268.0	268.2	268.0	267.7
267.3	266.8	266.2	265.6	265.1	264.5	263.9	263.3	262.7	262.3
261.7	261.3	260.7	260.4	260.0	259.6	259.5	259.3	258.6	258.1
257.8	257.6	257.4	257.2	256.9	256.6				

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	48261.	45601.	30358.	17966.	826447.
CMS	1367.	1291.	860.	509.	23402.
INCHES		6.50	17.30	19.62	19.62
MM		165.00	439.39	498.40	498.40
AC-FT		22612.	60215.	68301.	68301.
THOUS CU M		27892.	74274.	84249.	84249.

MAXIMUM STORAGE = 224.

MAXIMUM STAGE IS 268.2

HYDROGRAPH ROUTING

CHANNEL ROUTING -MODIFIED PULS- STATION 3 TO 4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0450	.1000	243.0	280.0	1380.	.00600

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

6.00	280.00	109.00	266.60	600.00	244.00	600.00	243.00	675.00	243.00
675.00	246.00	950.00	260.00	1000.00	280.60				

STORAGE	0.00	4.36	9.30	19.75	36.30	59.28	88.45	123.88	169.57	213.50
	267.04	325.96	393.25	459.92	534.96	615.36	701.18	792.39	888.89	990.82
OUTFLOW	0.00	564.75	1775.76	3780.93	6904.42	11369.53	17403.17	25207.49	34972.53	46973.49
	61713.95	79075.60	99115.57	121901.59	147544.22	176139.87	207792.45	242606.82	280687.94	322140.37
STAGE	243.00	244.95	246.89	248.84	250.79	252.74	254.68	256.63	258.58	260.53
	262.47	264.42	266.37	268.32	270.26	272.21	274.16	276.11	278.05	280.60
FLOW	6.00	564.75	1776.76	3780.93	6904.42	11369.53	17403.17	25207.49	34972.53	46973.49
	61713.95	79075.60	99110.57	121901.59	147544.22	176139.87	207792.45	242636.02	280687.94	322140.37

STATION 4, PLAN 1, RTIO 4

OUTFLOW

5604.	0.	3996.	2455.	4674.	5211.	7985.	11C79.	15112.	1953C.
24295.	29098.	34318.	3747C.	4132C.	44538.	46429.	48349.	47212.	45278.
42199.	39001.	35033.	31442.	28360.	25246.	21776.	18065.	16224.	14620.
12448.	10632.	9046.	7873.	6852.	5834.	5692.	5269.	4014.	3241.
2878.	2544.	2403.	2060.	1893.	1625.				

STOR

29.	0.	21.	13.	24.	27.	42.	58.	77.	98.
120.	140.	163.	176.	191.	204.	211.	218.	214.	207.
194.	18C.	166.	150.	137.	124.	108.	95.	83.	75.
64.	56.	47.	41.	36.	31.	30.	28.	21.	17.
15.	13.	13.	11.	1C.	9.				

STAGE

253.6	243.0	249.0	247.6	249.4	249.7	251.3	252.6	253.9	255.2
256.4	257.4	258.4	259.0	259.6	26C.1	260.4	26C.7	260.6	260.3
259.8	259.2	258.6	257.9	257.3	256.6	255.8	255.0	254.3	253.8
253.1	252.4	251.7	251.2	250.8	250.1	250.0	249.8	249.0	248.3
248.0	247.6	247.9	247.2	247.0	246.7				

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	48349.	45594.	30360.	17979.	827C21.
CMS	1369.	1291.	860.	509.	23419.
INCHES		6.50	17.30	19.64	19.64
MM		164.98	439.41	498.74	498.74
AC-FT		22609.	60217.	68349.	68349.
THOUS CU M		27887.	74277.	84307.	84307.

MAXIMUM STORAGE = 218.

MAXIMUM STAGE IS 260.7

D-I

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .25	RATIO 2 .50	RATIO 3 .75	RATIO 4 1.00
					RATIOS APPLIED TO FLOWS		
HYDROGRAPH AT	1	65.30	1	12125.	2425C.	36375.	48500.
	(	169.13)	(	343.34)(	686.68)(	1030.03)(	1373.37)(
ROUTED TO	2	65.30	1	12034.	24129.	38710.	48080.
	(	169.13)	(	340.76)(	683.26)(	1096.14)(	1361.49)(
ROUTED TO	3	65.30	1	1200C.	24061.	37499.	48261.
	(	169.13)	(	339.80)(	681.34)(	1061.86)(	1366.60)(
ROUTED TO	4	65.30	1	11999.	24031.	36459.	48349.
	(	169.13)	(	339.77)(	680.47)(	1032.41)(	1369.10)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	301.00	301.00	320.03
STORAGE	540.	540.	134C.
OUTFLOW	0.	0.	77133.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.25	307.64	0.0C	703.	12C34.	0.00	18.00	C.CO
.50	310.66	0.CO	9C1.	24129.	0.CC	18.CO	0.00
.75	312.53	0.0C	989.	3371C.	0.CO	19.00	0.CO
1.00	313.01	0.00	1049.	480FO.	0.CO	18.00	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.25	12000.	261.7	18.00
.50	24061.	264.4	18.00
.75	37499.	266.6	19.0C
1.C0	48261.	268.2	18.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.25	11999.	252.9	18.00
.50	24031.	256.3	18.00
.75	36459.	258.8	19.00
1.00	48349.	260.7	18.00

DIMENSIONS

S. BR. RARITAN RIVER

DAMS IN NEW JERSEY—REFERENCE DATA

No. 24-57

Name of Owner ~~Taylor Iron & Steel Co.~~ [illegible] Address ~~High Bridge, N. J.~~ Peapack, NJ 07977 Equipment

Name of Dam Lake Solitude ~~[illegible]~~ County Hunterdon Location 24.24.4.9.4

CONSTRUCTION: Date December 1909. By whom F. S. Tainter

Stream So. Br. Raritan River Tributary to Raritan River

DRAINAGE BASIN: Area 64 sq. mi. Description

Description of valley below dam

DAMAGE FROM FAILURE: Probable

Previous (date)

Purpose Power Type Coursed rubble masonry. Concrete core, Steel I beam reinforcement.

Foundation Granite

Length 210 ft. Max. height 42 ft. Max. width of base 40 ft.

Upstream slope Vertical Downstream slope .29' in 1' Volume Cu. yds.

SPILLWAY: Type Whole dam Length 210 ft.

Depth below top of ft. Capacity c. f. s. per sq. mi.

RESERVOIR: Capacity mill. gals. Area acres. Length ft.

Outlets

Remarks

Sources of data Letter from F. S. Tainter July 11, 1923. J. N. B. Date 1/4/26

D-16

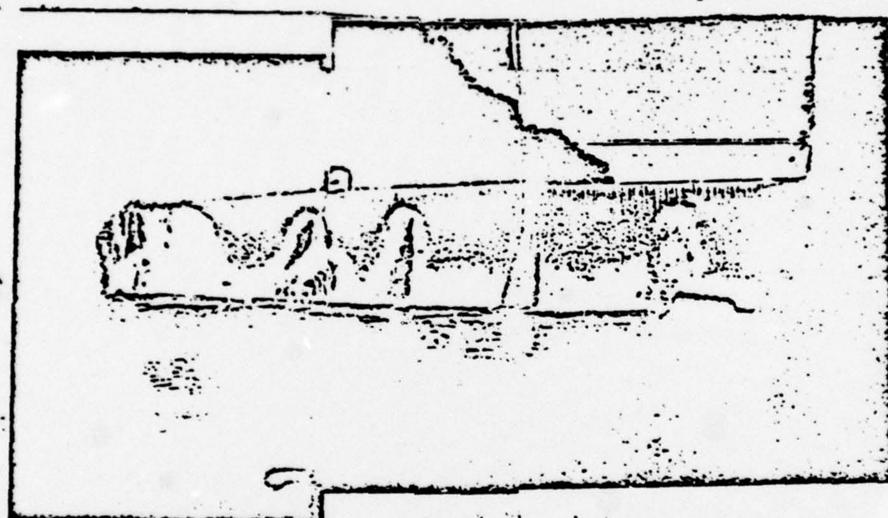
DAM-INSPECTION

LAKE SOLITUDE
DAM NO. 24-57
June 2, 1978

Lake Solitude Dam is constructed across the South Branch of the Raritan River more or less than 4000 feet upstream of the Central Railroad of New Jersey's bridge over the South Branch of Raritan River in the Borough of High Bridge, Hunterdon County, New Jersey.

The spillway is more or less than 210 feet in length, 4 feet wide at the top, 40 feet wide at the base and approximately 42 feet high. The entire structure is constructed of Keyed and grouted masonry blocks. The face is vertical with 3 buttress walls incorporated into the face.

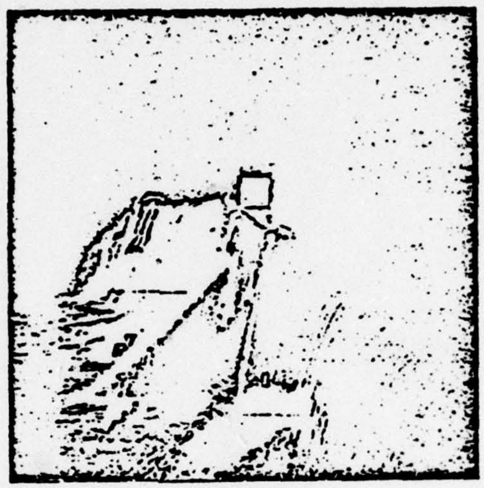
Photograph one (1) shows a panorama view of the entire spillway face.



PHOTOGRAPH-1

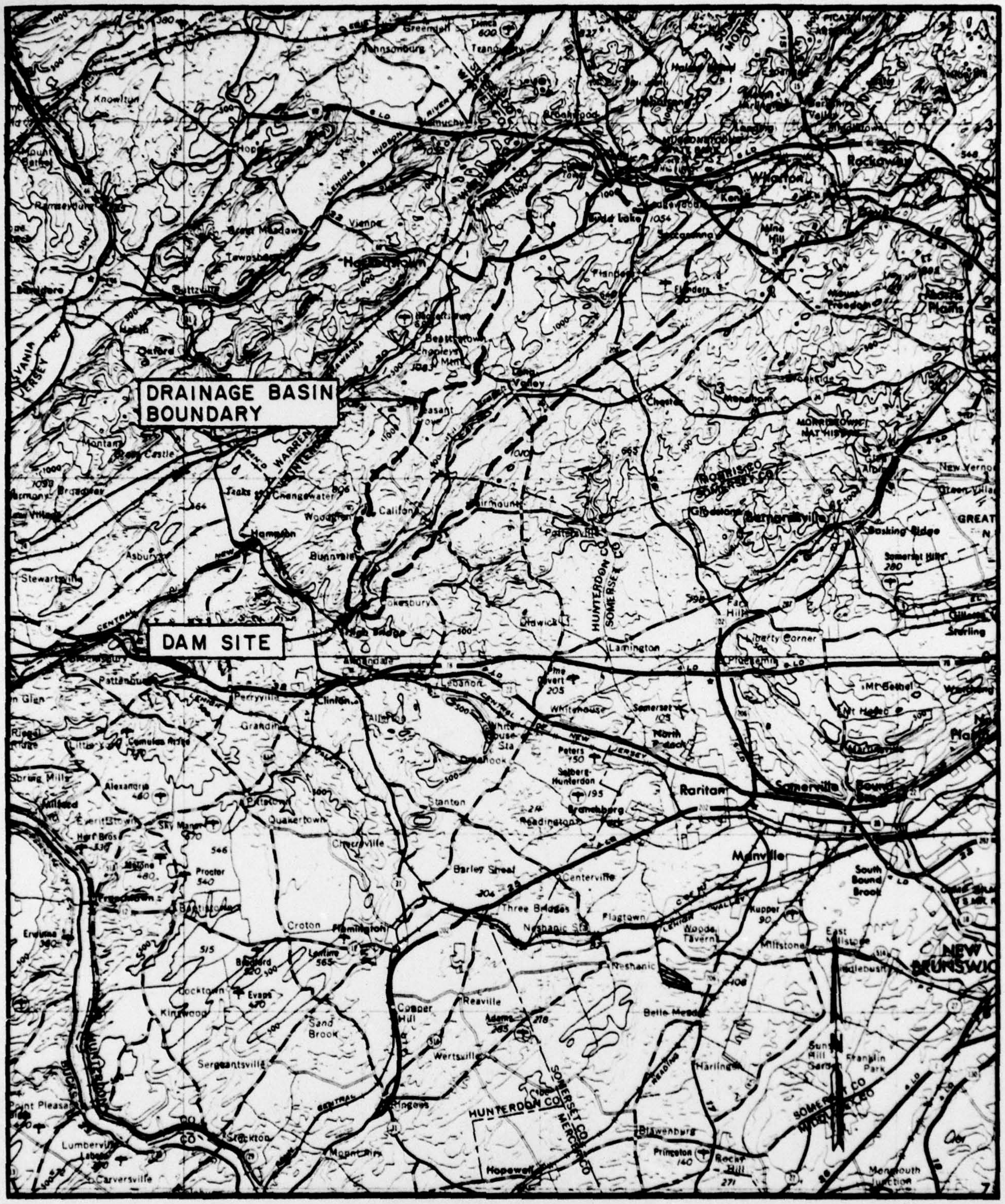
The water immediately upstream of the spillway face is approximately 5 feet deep. Also, a considerable amount of silt was seen within the impoundment.

Constructed on top of the spillway is a white shed which appeared to contain gates and valves. This could not be inspected because there was no access to it from the banks. This is shown in photograph 2.



PHOTOGRAPH 2

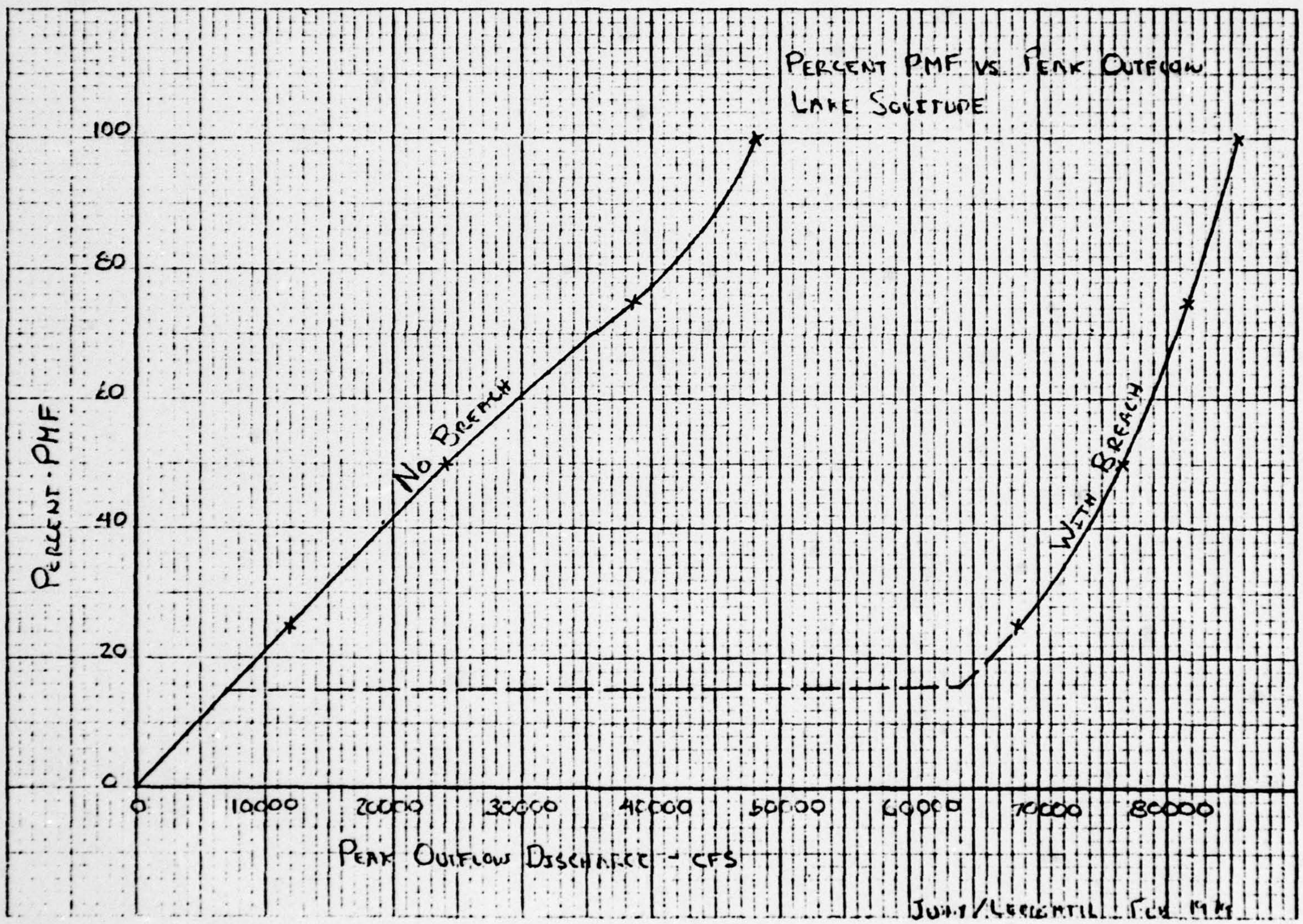
The stilling basin downstream of the spillway measured more or less than 50 feet and had numerous rocks at the invert. The stilling basin continued for more or less than 250 feet downstream before the stream channel started. The stilling basin appeared to be very effective and was well stabilized against erosion. No signs of scour or undermining were seen and no obstructions to the flow of water were evident.



AREA LOCATION

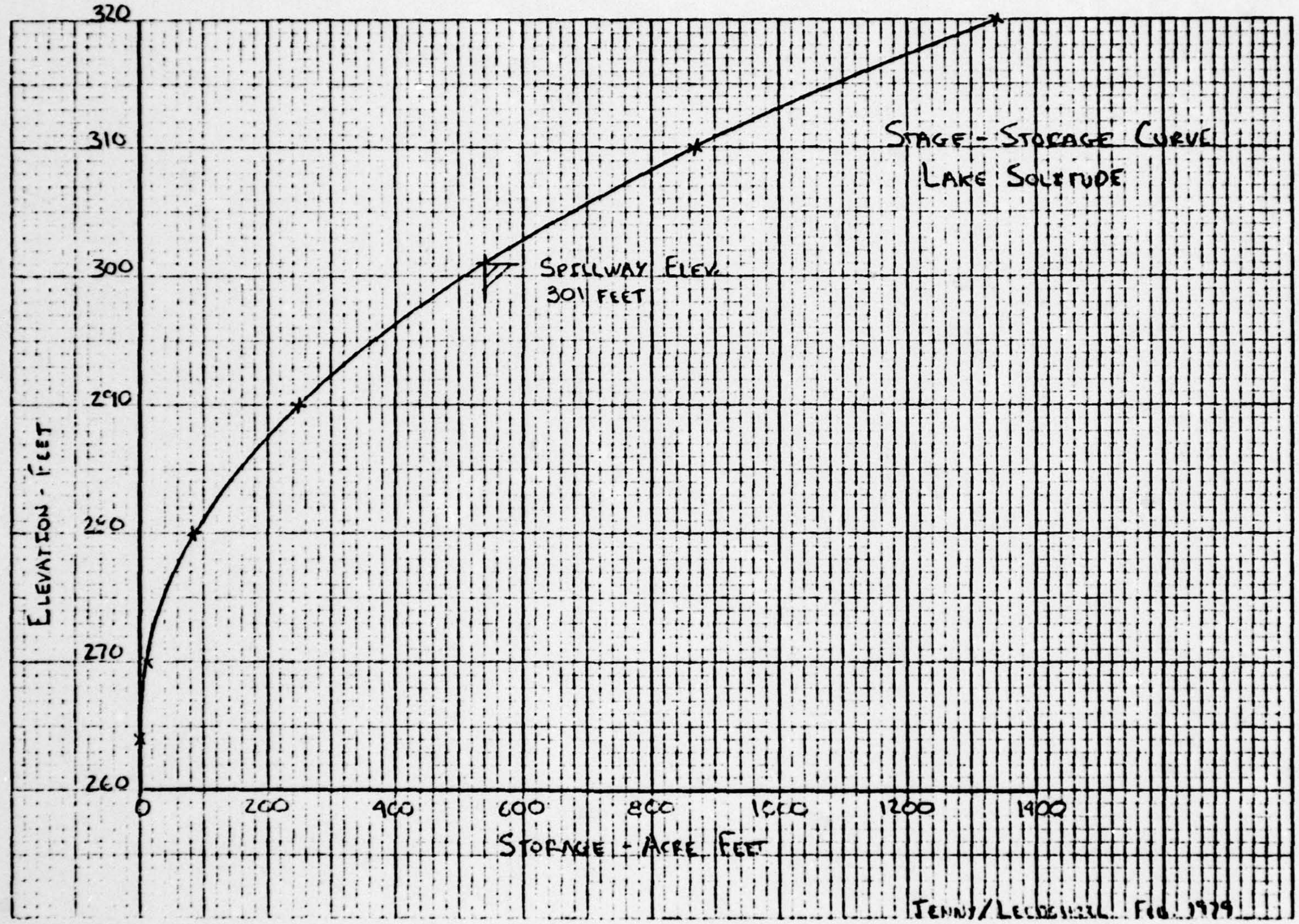
LAKE SOLITUDE DAM

JENNY-LEEDSHILL JANUARY 1979



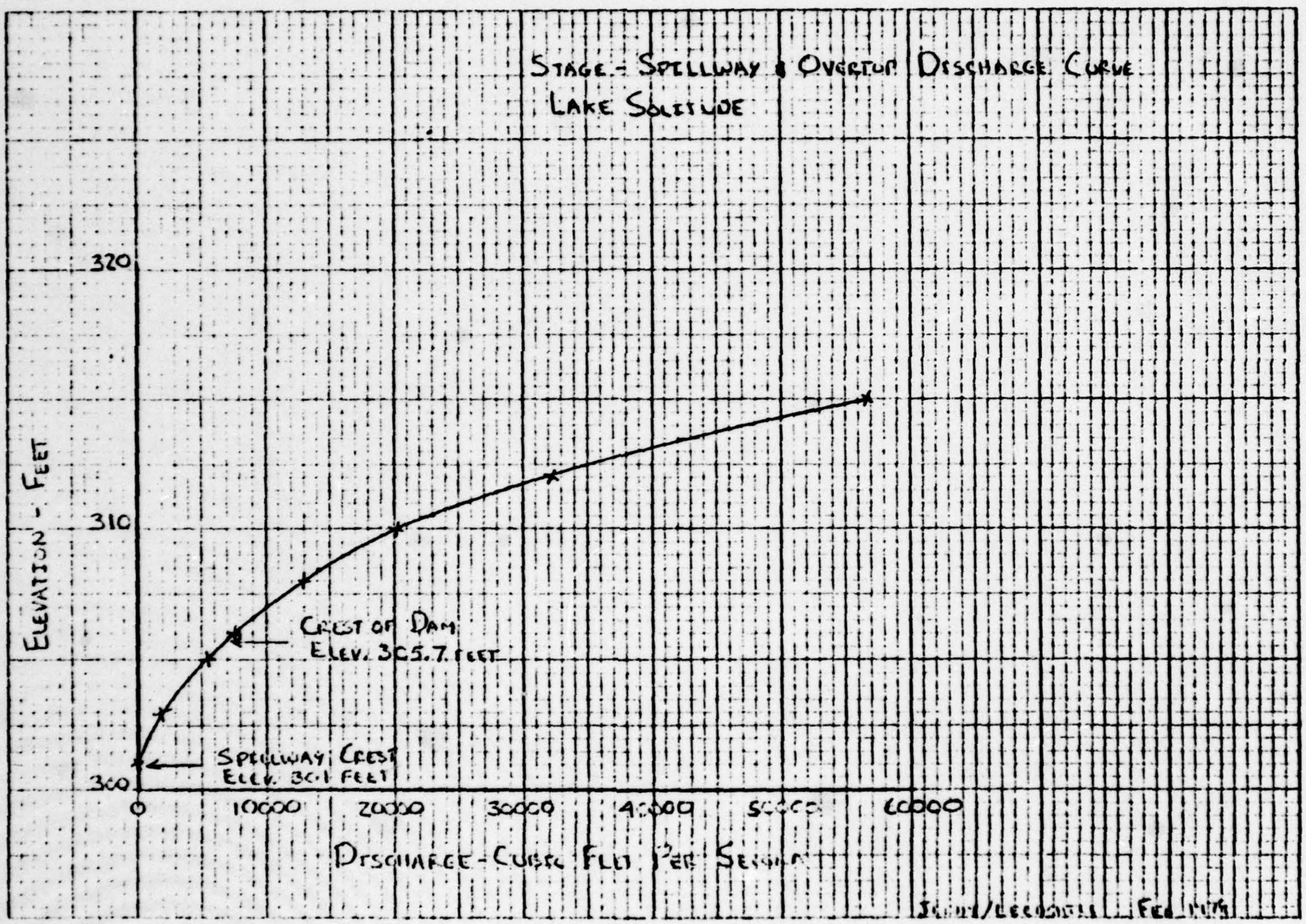
PERCENT PMF VS. PEAK OUTFLOW
LAKE SOLITUDE
100
80
60
40
20
0
PERCENT · PMF
NO BREACH
WITH BREACH
0
10000
20000
30000
40000
50000
60000
70000
80000
PEAK OUTFLOW DISCHARGE - CFS

D-2



D-3

JENNY/LECDEIIIAL FEB 1979


STAGE - SPILLWAY & OVERTOP DISCHARGE CURVE
LAKE SOLITUDE
ELEVATION - FEET
320
310
300
CREST OF DAM
ELEV. 305.7 FEET
SPILLWAY CREST
ELEV. 301 FEET
0
10000
20000
30000
40000
60000
DISCHARGE - CUBIC FEET PER SECOND

D-4

LEEDS, HILL AND JEWETT, INC.

BY RBC DATE 790208 CLIENT N.J. SHEET NO. 1 OF 3

CHKD. DATE JOB LAKE SOLITUDE JOB NO. 302-03

PEAK DISCHARGE FOR DAM BREACH[1]

% PMF	MAX W.S.E.L NO BREACH[2]	DEPTH H (FT)[3]	DISCHARGE NO BREACH (CFS)[2] Q_2 OVER DAM	Q @ STA 4	Q_4/Q_2	FLOW AREA @ 4/9 H (FT²)[4]	Q_B FOR DAM BREACH (CFS)[5]	Q_B @ STA 4 (CFS)[6]	STAGE ELEV. @ STA 4
25	307.64	39.6	12030	12000	0.95	2870	68320	64900	262.7
50	310.66	42.7	24130	24030	0.95	3100	76630	72800	263.7
75	312.53	44.5	38710	36460	0.95	3240	81760	77670	264.2
100	313.81	45.8	48080	47890[9]	0.95	3340	85510	81230	269.6

1. INSTANTANEOUS FAILURE
2. FROM HEC-1DB RUN
3. W.S.E.L. - El. 268 (BOTTOM OF AVG SECTION)
4. FROM IDEALIZED CROSS-SECTION OF DAM
5. $$Q_B = \left(\tfrac{2}{3}\sqrt{gH}\, A_{4/9}\right)$$
6. $Q_{B @ STA 4} = Q_{B @ STA 2}\,(Q_4/Q_2)$
7. FROM HEC1DB GENERATED STAGE DISCHARGE CURVE FOR STA
8. BOTTOM ELEV. @ STA 4 IS 243
9. CORRECTED SO THAT Q_4 IS LESS THAN Q_2 (CONSERVATIVE)

10. USED AN AVERAGE ATTENUATION OF 0.95. ACTUAL ATTENUATION WILL BE SOMEWHAT GREATER

NORMAL DEPTH CHANNEL ROUTING

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   QN(1)   QN(2)   QN(3)   ELNVT   ELMAX   RLNTH     SEL
   .1000   .0450   .1000   243.0   280.0   1300.  .00800

   CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
      0.00  280.00  100.00  266.66  400.00  246.00  600.00  243.00  675.00  243.00
    675.00  246.00  950.00  260.00 1800.00  280.00

 STORAGE       0.00       4.56       9.36      19.75      36.38      59.28      88.45     123.88     165.57     213.50
             267.04     325.96     393.25     459.92     534.96     615.38     701.18     792.35     888.89     990.82

 OUTFLOW       0.00     904.75    1775.76    3789.93    6904.42   11369.53   17403.17   25207.49   34972.53   46973.49
           61713.95   79079.40   99112.57  121901.59  147944.22  176139.87  207792.45  242806.82  280687.94  322146.37

   STAGE     243.00     244.95     246.89     248.84     250.79     252.74     254.68     256.63     258.58     260.53
             262.47     264.42     266.37     268.32     270.26     272.21     274.16     276.11     278.05     280.00

    FLOW       0.00     904.75    1776.76    3788.93    6904.42   11369.53   17403.17   25207.49   34972.53   46973.49
           61713.95   79079.00   99110.57  121901.59  147944.22  176139.87  207792.45  242636.82  280687.94  322140.37
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